Chapter 3
Socioeconomic Characteristics of the Planning Area

A. Purpose

The purpose of this chapter is to project population changes in the Brandenburg Planning Area for the period from 2020 to 2040. Data presented here are from a combination of 2015 U.S. Census Data and 2016 U.S. Census Bureau American Community Survey. Population projections are important, as estimated flows for the wastewater collection system and treatment plant are based on the population served. A completely accurate procedure to develop long-term population projections does not exist, as factors such as changes in economic development can alter long-range estimates. The standard procedure for projecting population estimates is to review past population changes patterns for the area in question and utilize these patterns, along with expected land use designations and specific development knowledge, to project future changes.

The current socioeconomic conditions, labor force, income, educational facilities, community facilities, housing, and transportation and access are also presented.

B. Population Trends

The 2010 U.S. Census reported a population of 2,643 for the City of Brandenburg. The 2010 Brandenburg population predicted by the 1990 Brandenburg Wastewater Facilities Plan was 2,431, so the City grew at a quicker rate than was predicted in 1990.

Annual population estimates for the State of Kentucky, Meade County, and the City of Brandenburg for the years 2011 to 2015, were obtained from the U.S. Census Bureau Population Division via the Kentucky State Data Center. The Kentucky State Data Center has also issued population projections for five-year intervals at the State and County level through the year 2040. The 2010 Census population data, the annual population estimates, and the five-year population projections were used to develop Kentucky, Meade County and Brandenburg population projections for each year through 2040.

The estimates for the years between the five-year population projections were interpolated with each year growing by the same number of people. The population estimates for the City of Brandenburg beyond the 2015 estimate by the State Data Center were determined by applying the changes percentages for Meade County to the City through 2040, which assumes that Brandenburg population will change at the same rate as the county for this time period.

As an addition to the existing population projections, the total population that is anticipated due to the impact of the Nucor Corp workforce and the ancillary light industrial and commercial development are illustrated. The population projections are provided in Exhibit 3-1.

C. Labor Force

According to U.S. Census data, 58.8% of Brandenburg's population 16 and over was in the labor force in 2010, of which 19.3% were unemployed. Based on 2015 U.S. Census data estimates, 58.3% of the City's population 16 and over was in the labor force, of which 18.2% were unemployed. Total unemployment rates for the City of Brandenburg and State of Kentucky were 8.7% and 4.5% in 2016, respectively based on the U.S. Census Bureau American Community Survey.

The City's civilian labor force was estimated as 1,061 persons by the U.S. Census Bureau for 2015. The top five employment classifications for the City of Brandenburg, according to 2015 estimates are:

- Educational services, and heath care and social assistance (27.7%)
- Arts, entertainment, and recreation, and accommodation and food services (15.3%)
- Retail Trade (9.8%)
- Professional, scientific, and management, and administrative and waste management services (9.3%)
- Manufacturing (8.4%)

D. *Income*

The City of Brandenburg's per capita and median household income estimates by the 2016 U.S. Census Bureau American Community Survey data were $20,370 and $40,875, respectively. These compare to $24,802 and $44,811 median household income for the State of Kentucky from the same Census estimates. Both values are lower for the City than the State.

Also from the 2015 U.S. Census estimates, 21.8% of families and 28.0% of people were estimated to be living below the poverty level in the City of Brandenburg. This compares to 14.4% of families and 18.9% of people living below the poverty level for the State of Kentucky. The City of Brandenburg has a higher poverty percentage in both categories compared to the State of Kentucky.

E. *Educational Facilities*

The public schools in the City of Brandenburg are part of the Meade County Schools system. There are eight schools in total: two primary, four elementary, one middle, and one high school. The four Meade County Schools located within Brandenburg's city limits are Brandenburg Primary, David T. Wilson Elementary, Stuart Pepper Middle School, and Meade County High School. In addition to the four public schools, the City of Brandenburg also has one private school, St. John The Apostle School, and one technology center, Meade County Area Technology Center.

F. *Community Facilities*

Government offices and facilities for Meade County are located in the City of Brandenburg, the county seat. The Meade County Courthouse, located on Hillcrest Drive, houses offices of the county judge/executive, county court clerk, county attorney, vehicle registration, and jail. The Meade County chamber of commerce, PVA, road department garage, solid waste department, board of education, water district, public library, and fire protection district are also located within the city limits.

There are two city parks located in Brandenburg; Meade-Olin Park located in the eastern part of the City on Moremen Road, and Brandenburg Riverfront Park located in the northern part of the City on River Road. Meade-Olin Park includes tennis courts, ball fields, soccer field, basketball courts, disc golf, picnic areas, shelter area, and playground. Brandenburg Riverfront Park, located on the Ohio River, includes boat ramps, picnic areas, soccer fields, two pavilions, playground, checkers/chess table, amphitheater, and a gazebo.

Commercial facilities include the Meade County Activities Center and Lynn's Pins. The Meade County Activities Center includes a fitness center, 9-hole golf course, driving range, putting/chipping green, pool, and tennis courts.

In addition, the Otter Creek Outdoor Recreation Area is located within 20 minutes of the City of Brandenburg. Otter Creek is a 3,600-acre woodland with 24-unit lodges, 165 campsites, horseback riding, hiking trails, tennis, basketball, volleyball, a playground, and picnic pavilions.

G. *Housing*

The 2015 U.S. Census data reported that there were 1,292 housing units in the City of Brandenburg. Of those, 1,068, or 82.7% of total units were occupied and 224, or 17.3%, of the total units were vacant. 2016 U.S. Census Bureau American Community Survey data reports rental property made up 50.5% of the total occupied housing units. This compares to 87.9% total units occupied and rental property making up 32.8% of total occupied housing units in the State of Kentucky. The City of Brandenburg has a higher vacancy and rental property percentage compared to the State.

The City's median house value in 2016 was $129,900 for owner occupied units. The median rent for renter occupied units in the City was $600. Both of these statistics are comparable to the State of Kentucky's median house value of $126,100 and approximately 13% less than median rent value of $690 for the same census estimate.

H. Transportation and Access

The City of Brandenburg is accessible from Corydon, IN to the north via I-64 and IN-135, from Fort Knox, KY to the east via US 31W and KY-1638, from Irvington, KY to the south via US 60 and KY-79, and from Payneville, KY to the west via KY-144 and KY-79.

The nearest private air service to the City of Brandenburg is provided at Breckinridge County Airport, which is located approximately 29 miles to the south. The nearest scheduled commercial air service is provided at the Louisville International Airport, which is located approximately 50 miles northeast of Brandenburg.

The Ohio River borders the City of Brandenburg and Meade County to the north. Public boat ramps can be found at the Brandenburg Riverfront Park located on the northern side of the City.

I. Economic and Social Benefit to the Community

The availability of a well operated and maintained wastewater system, with available capacity that allows for the community's residential, commercial, and industrial expansion during the next 20 years, provides the backbone for economic changes and development. When combined with the implementation of other infrastructure and social projects, the Wastewater Facilities Plan establishes a means to attract new businesses to the Planning Area, which in turn equates to improved socioeconomic conditions and to an environment that supports expanded residential changes.

Exhibit 3-1

Kentucky, Meade County, and City of Brandenburg Population Esimates and Projections

Year	Meade County*		City of Brandenburg		Population Projections Nucor Population Impact§		
	Population	% Change	Population	% Change	Meade County Projected Population	Brandenburg Projected Population	% Change
2020	29,957 [1]		2,880 [3]				
		-2.17%		-2.22%			
2021	29,322 [2]		2,818 [3]				
		-2.22%		-2.27%			
2022	28,686 [2]		2,755 [3]		29,293	2,844	2.07%
		-2.27%		-2.32%			
2023	28,051 [2]		2,693 [3]		28,658	2,782	2.12%
		-2.32%		-2.37%			
2024	27,415 [2]		2,630 [3]		28,022	2,719	2.17%
		-2.37%		-2.43%			
2025	26,780 [1]		2,568 [3]		27,387	2,657	2.22%
		-0.57%		-0.57%			
2026	26,629 [2]		2,553 [3]		27,236	2,642	2.23%
		-0.57%		-0.57%			
2027	26,478 [2]		2,539 [3]		27,085	2,628	2.24%
		-0.57%		-0.58%			
2028	26,327 [2]		2,524 [3]		26,934	2,613	2.25%
		-0.58%		-0.58%			
2029	26,176 [2]		2,510 [3]		26,783	2,599	2.27%
		-0.58%		-0.58%			
2030	26,025 [1]		2,495 [3]		26,632	2,584	2.28%
		-0.69%		-0.70%			
2031	25,845 [2]		2,478 [3]		26,452	2,567	2.29%
		-0.70%		-0.70%			
2032	25,666 [2]		2,460 [3]		26,273	2,549	2.31%
		-0.70%		-0.71%			
2033	25,486 [2]		2,443 [3]		26,093	2,532	2.33%
		-0.71%		-0.71%			
2034	25,307 [2]		2,426 [3]		25,914	2,515	2.34%
		-0.71%		-0.72%			
2035	25,127 [1]		2,408 [3]		25,734	2,497	2.36%
		-0.85%		-0.86%			
2036	24,915 [2]		2,388 [3]		25,522	2,477	2.38%
		-0.86%		-0.86%			
2037	24,703 [2]		2,368 [3]		25,310	2,457	2.40%
		-0.86%		-0.87%			
2038	24,492 [2]		2,347 [3]		25,099	2,436	2.42%
		-0.87%		-0.88%			
2039	24,280 [2]		2,327 [3]		24,887	2,416	2.44%
		-0.88%		-0.89%			
2040	24,068 [1]		2,306 [3]		24,675	2,395	2.46%

* Meade County population estimates and projections include City of Brandenburg's population

[1] Population Projections 2020 -2040 Kentucky State Data Center, University of Louisville, Vintage 2016, 2019

[2] Interpolated

[3] Extrapolated from Meade County projected population change rate

§ Population adjustment projections in 2022 of 607 persons equals one-half of expected Nucor workforce, and associated households, relocated to Meade County/Brandenburg. Plus resultant commerce and light industry population.

Chapter 4
Wastewater Flows and Characteristics

A. *Purpose*

The purpose of this chapter is to project the flows and characteristics of wastewater generated within the Planning Area for the Planning Period from 2020 through 2040. These flow rates and characteristics will be used in the design of wastewater collection and treatment systems upgrades to meet Kentucky Pollutant Discharge Elimination System (KPDES) permit requirements and discharge limitations throughout the Planning Period. This chapter details the existing and projected wastewater flows and characteristics.

B. *Existing Wastewater Flows*

Wastewater in the City of Brandenburg is treated at the Brandenburg WWTP, which is located east of the city limits. The Brandenburg WWTP currently has a rated average daily treatment capacity of 0.312 million gallons per day (MGD) and a peak hydraulic capacity of 0.932 MGD.

The average daily flow (ADF) to the Brandenburg WWTP over the last three years (July 2017 through June 2020) was 0.232 MGD and the peak day flow (PDF) over the same time period was 0.697 MGD in November 2019.

ADF and peak day flows for the last three years (expressed as July 1 to June 30 of the following year) are provided in Table 4-1 and plant performance data for the same time period is tabulated in Exhibit 4-1.

Table 4-1
Average and Peak Day Flows
Brandenburg WWTP

Year	Average Daily Flow (MGD)	Peak Day Flow (MGD)
2017-2018	0.223	0.633
2018-2019	0.233	0.687
2019-2020	0.239	0.697

C. *Industrial Dischargers*

Monument Chemical is the only industrial discharger located near Brandenburg's Planning Area. Monument Chemical has its own 9.34 MGD on-site treatment plant (KPDES Permit No. KY0002119), which does not discharge to Brandenburg's WWTP. As a result, there are no industrial discharges to the City's Collection System.

D. *Projected Wastewater Flows*

In January 2020, Brandenburg had approximately 1,412 sewer customers. The total population served by the sewer system is estimated to be approximately 2,880. The approximate number of sewer customers were based on information provided by City staff. The estimated population served was extrapolated from the 2019 population estimate (Census Bureau, American FactFinder, Community Facts, Population Estimate Program) and Meade County population growth rate (University of Louisville, Kentucky State Data Center). Taking the average daily flow of 0.232 MGD (2017 through 2020) and dividing it by the total system customers gives an average flow per customer of 162.6 GPD. This number takes into account all classes of customer.

The average flow per customer was then used to calculate future flows for the existing service area, while land use maps were used to calculate future flows for expansion areas.

Exhibit 4-2, Wastewater Flow Projections, contains the flow rates projected from the present through 2040 (the end of the Planning Period) used for this study. The average wastewater flow per day for the year 2040 is estimated to be 0.496 million gallons. An assumed peaking factor of 3 was used and as a result, the peak hourly flow has been estimated at 1.488 million gallons per day.

Exhibit 4-2 shows the projected flow rates broken down into several components. The following is a description of the manner in which each of those components was calculated:

1. Average Wastewater Flow (Existing Service Area)

The flow component for the existing service area was calculated using population projections from the Kentucky State Data Center at the University of Louisville. The projected number of sewer customers was calculated by applying the projected population changes to the number of sewer customers as provided by the City. As stated previously, the Brandenburg wastewater system served approximately 1,412 customers as of January 2020.

The average flow per customer of 162.6 GPCD has increased since the 1990 Facilities Plan, which had an average flow per customer of 133 GPCD, and remained fairly constant since the 2017 Facilities Plan which had an average flow per customer of 166.5. This shows that there has potentially been an increase in inflow and infiltration (I & I) since the 1990 Facilities Plan. An increase in I & I isn't uncommon when a system has aging vitrified clay piping. Additionally, the 2017 to 2020 slight decrease highlights potential water conservation practices and expanded use of low flow water devices.

2. Expansion Areas

Based on meetings with the Brandenburg Mayor and City Staff, a future land use map was developed (see Future Land Use Map in Exhibit 2-5). The projected wastewater flows in the expansion area were calculated using the Louisville and Jefferson County Metropolitan Sewer District's (MSD's) Design Manual. The suggested flows for agricultural, industrial, commercial, and residential land use are 0, 1,000, 2,000, and 400 gallons per acre per day, respectively. However, since the residential expansion area includes existing residential neighborhoods the 400 gallons per acre per day was not applied. Instead, the existing houses were counted within each area and the average flow per customer of 162.6 GPCD was applied to each house to develop the future wastewater flows. Table 4-2 shown below summarizes the projected additional future land use wastewater flows.

Table 4-2
Future Land Use
20-Year Wastewater Flow Projections

Land Use Designation	Acre	Avg Gal/ Acre/Day
Agriculture	0	0
Industrial	30	30,000
Commercial	100	200,000
Land Use Designation	**Homes**	**Avg Gal/ Homes/Day**
Single Family Residential	252	40,975

The conversion from what is identified as Agricultural land in the 2017 Facility Plan Planning Area to Industrial land acquired by Nucor Corp has no net effect on flow projections. Nucor Corp will be providing wastewater treatment services for its own facility. It is anticipated the inclusion of Nucor Corp in the Planning Area will increase both Industrial and Commercial development in and around the site. Because of no net effect imparted by the inclusion of Nucor Corp in the Planning Area all further discussion or calculations based on Expansion Areas will NOT include those encompassed by the Nucor Corp. facility or their acquired area.

a. Expansion Area No. 1 (0-2 Year Development)

The City of Brandenburg doesn't have any planned expansion for the 0-2 year development period. During the 0-2 year development period, the City intends to replace the Brandenburg WWTP based on the recommendations herein. Expansion Area No. 1 does include the Nucor facility, which will not contribute any wastewater flow to the Brandenburg WWTP. Nucor is anticipated to cover approximately 600 acres of land in the Brandenburg and Meade County area.

b. Expansion Area No. 2 (3-10 Year Development)

Expansion Area No. 2 consists of two existing neighborhoods, and is located south of the existing service area (see Exhibit 2-6 for Planning Area Phasing). One neighborhood is located along Four Oaks Road and Miles Lane off By Pass Road. The second neighborhood is along Quail Run Road, Oakwood Drive, Rebecca Court, Blaine Court, Knollwood Road, and Kelly Lane off Old State Road. This area currently has 105 homes on Brandenburg's water system and all homes are assumed to be on septic tanks. Land use in Expansion Area No. 2 is projected as follows (also see Exhibit 2-5):

Table 4-3
Expansion Area No. 2 (3-10 Year)
Future Land Use

Land Use Designation	Future Acreage	# of Homes
Single Family Residential	266	105
Commercial	60	-
Industrial	20	-

The projected average daily flow for Expansion Area No. 2 is approximately 157,073 GPD (see Exhibit 4-2). For the purpose of projections, the total expansion area flow is distributed evenly over the development period of 3-10 years.

c. Expansion Area No. 3 (11-20 Year Development)

Expansion Area No. 3 is the largest expansion area consisting of residential, commercial and industrial development (see Exhibit 2-5 for Planning Area Boundary and Phases). On the western side of the area, two existing neighborhoods are being added to the service area. One neighborhood is located along Fairgrounds Road, Sun Valley Road, and Windsor Place off By Pass Road. The second neighborhood is located along River Edge Drive and River Edge Road off Battletown Road. This area has 82 homes that are currently on Brandenburg's water system, and all homes are assumed to be on septic tanks. On the eastern side of the service area, one existing neighborhood and future agricultural and industrial development are being added to the service area. The existing neighborhood is located along Christian Church Road, Bud Wilson Road, and Wilson Place off KY 933. This area currently has 65 homes on Brandenburg's water system, and all homes are assumed to be on septic tanks. The large agricultural development area defined in the 2017 Facilities Plan is converted to Industrial and Commercial in this 2020 Facilities Plan and includes the Nucor facility and the anticipated ancillary development associated with Nucor's inclusion. The only remaining land not converted is the site of the Brandenburg WWTP, which will be surrounded by Nucor property.

Land use in Expansion Area No. 3 is projected as follows (also see Exhibit 2-5):

Table 4-4
Expansion Area No. 3 (11-20 Year)
Future Land Use

Land Use Designation	Future Acreage	% of Total Area
Commercial	40	8.4%
Industrial	10	2.1%
Single Family Residential	428	89.5%
Total Area	**478**	**100.0%**

The projected average daily flow for Expansion Area No. 3 is approximately 148,073 GPD (see Exhibit 4-2). For the purpose of projections, the total expansion area flow is distributed evenly over the development period of 11-20 years.

E. ***Wastewater Characteristics***

Raw wastewater strengths for five-day biochemical oxygen demand (BOD_5) and total suspended solids (TSS) at the Brandenburg WWTP are summarized for the time period from July 2017 through June 2020 in Exhibit 4-1. The average influent BOD_5 and TSS values between July 2017 and June 2020 were 361 mg/l (700 lbs/day) and 307 mg/l (591 lbs/day), respectively. Neither value currently exceeds the new plant design capacity.

The existing plant's design removal efficiencies for BOD_5 and TSS are both 90%, respectively, while average removal efficiency between 2017 and 2020 for BOD_5 and TSS are 96.7% and 90.7%, respectively. During the last three years from July 1, 2017 to June 30, 2020, there were 12 months (33% of data) when the TSS removal efficiency was below the 90% design criteria with the lowest percentage at 10% in December 2019. There were no instances when the BOD removal did not meet the 90% design criteria. The potential causes for the poor TSS removal efficiency will be discussed in more detail later in this plan.

The new plant's design loading capacities are 1,685 lbs/day BOD_5 and 1,601 lbs/day TSS with 90% removal efficiencies. The following are the projected waste loads for the Brandenburg WWTP for the planning period:

Table 4-5
Brandenburg WWTP
Projected Influent Waste Loads (2040)

Service Area	BOD_5 (lbs/day)	TSS (lbs/day)
Existing	407	479
Expansion Area No. 1	-	-
Expansion Area No. 2	440	483
Expansion Area No. 3	287	320
Total	**1135**	**1282**

Influent ammonia testing began in May 2018. Influent phosphorus concentrations isn't measured at Brandenburg's WWTP. The effluent ammonia and phosphorus concentrations for the time period between 2017 through 2020 averaged 2.0 mg/l and 5.77 mg/l, respectively. Brandenburg WWTP effluent ammonia has not exceeded the permitted Monthly Average of 20 mg/l or the Daily Maximum of 30 mg/l since testing began. Reduced removal, as anticipated, has occurred in the colder months, but there is no permit requirement for percent removal. Brandenburg's WWTP is not anticipated to receive a phosphorous limit due to their discharge being on the Ohio River.

The existing service area waste loads were based on the historic average waste loads (2014-2016). For the non-industrial waste loadings in the expansion area, 0.17 lbs BOD_5/population equivalent/day and 0.20 lbs TSS/population equivalent/day were used per Paragraph 11.253 of Ten State Standards. For industrial waste loads in the expansion areas, it was assumed that any future industrial development would only be disposing of domestic waste to Brandenburg's WWTP. A population equivalent of 10 persons per acre and the Ten State Standards for non-industrial waste loading was used to develop the industrial waste loadings.

The most recent influent BOD and TSS concentrations appear to have normalized from the higher than expected loadings for a City like Brandenburg. The high concentrations could potentially have been caused by poor food preparation and disposal practices at the local schools and restaurants. Using language found in their Sewer Use Ordinance (Appendix K), as well as other sources, the City approached resolving the high influent BOD and TSS concentrations through public outreach and education.

Therefore, the 2040 projected waste loads to the Brandenburg WWTP, when including the anticipated expansion of commercial and industrial areas and population, are 1,135 lbs/day (274 mg/l) BOD_5, and 1,282 lbs/day (310 mg/l) TSS, which are within the new plants rated design values.

F. ***Projected 2040 Influent Data***

The projected 2040 influent data are summarized in Table 4-6.

Table 4-6
Projected 2040 Influent Data Summary

Parameter	Value
Average Day Flow (MGD)	0.496
Peak Hourly Flow (MGD)	1.488
BOD_5 Concentration (mg/l)	274
BOD_5 Loading (lbs/day)	1,135
TSS Concentration (mg/l)	310
TSS Loading (lbs/day)	1,282

The existing average design flow for the WWTP is 0.312 MGD. The selected treatment alternative will be designed to treat 0.500 MGD. Based on a 0.500 MGD average design flow, the following are the 2040 influent design parameters:

Table 4-7
2040 Brandenburg WWTP
Influent Design Parameters

Influent Parameter	Value
Average Daily Flow	0.500 MGD
Peak Hydraulic Flow	1.500 MGD
BOD_5	1,685 lbs/day
BOD_5	404 mg/l
TSS	1,601 lbs/day
TSS	384 mg/l
Ammonia-Nitrogen	154.3 lbs/day*
Ammonia-Nitrogen	37 mg/l*

*Based on the most recent performance data and projected flows. The City began sampling influent ammonia-nitrogen in May 2018.

G. ***Inflow and Infiltration***

Infiltration is defined by the Water Environment Association (WEA) in their Manual of Practice FD-6, *Existing Sewer Evaluation & Rehabilitation* as "the water entering a sewer system and service connections from the ground, through such means as, but not limited to, defective pipes, pipe joints, connections, or manhole wall". Additionally, "infiltration does not include, and is distinguished from inflow".

Inflow is defined by FD-6 as "the water discharged into a sewer system and service connections from such sources as, but not limited to, roof leaders, cellar, yard and area drains, foundation drains, cooling water discharges, drains from springs and swampy areas, manhole covers, cross connections from storm and combined sewers, catch basins, storm water, surface runoff, street washes, or drainage. Additionally, it "does not include, and is distinguished from infiltration".

The Kentucky Division of Water has established the following guidelines for the recommendation of a sanitary sewer study:

1. Receive more than 275 gallons per capita per day of sewage flow based on the maximum flow received during a twenty-four (24) hour period exclusive of industrial flow; or

2. Receive more than 120 gallons per capita per day of sewage flow based on the annual average of daily flows exclusive of industrial flow.

Following is a calculation of the maximum and average daily flow per capita for the previous 36 month period (July 2017 through June 2020).

Average Daily Flow = 0.232 MGD

Maximum Daily Flow (24 hour period) = 0.697 MGD

Approximate Population Served = 2,880

Average Per Capita Flow = 80.55 GPCD

Max Daily Per Capita Flow = 242.01 GPCD

The average and maximum per capita flows are both below the DOW guidelines. Additionally, the peak factor ranges from 1.17 to 3.03 in the period of time from July 1, 2017 through June 30, 2020, with an average of 1.90. This is another indicator that the City's collection system is not experiencing severe I&I issues.

Based solely on the calculations above, the City's collection system is not showing severe signs of I&I. However, based on the majority of the system being 55+ year old vitrified clay pipe, it would be recommended that the City establish a CCTV program. This would allow the City to visually confirm that their collection system remains intact, as well as provide a systematic approach to correcting issues as they are discovered.

Exhibit 4-1
Performance Characteristics
City of Brandenburg Wastewater Treatment Plant

Year	Month	Influent Flow			Eff Flow	Influent TSS			Effluent TSS			TSS % Removal	Influent BOD			Effluent BOD			BOD % Removal	Effluent PH		Effluent Phosphorous	Effluent DO	Effluent E. Coli.	Influent NH_3N			Effluent NH_3N			NH_3N % Removal
		AVG	MAX	Peak Factor	AVG	AVG	MAX	AVG	AVG	MAX	AVG		AVG	MAX	AVG	AVG	MAX	AVG		MAX	MIN	AVG	AVG	AVG	AVG	MAX	AVG	AVG	MAX	AVG	
		(MGD)			(MGD)	(mg/l)		(lbs/day)	(mg/l)		(lbs/day)		(mg/l)		(lbs/day)	(mg/l)		(lbs/day)		(SU)		(mg/l)	(mg/l)	(#/100ml)	(mg/l)		(lbs/day)	(mg/l)		(lbs/day)	
2017	July	0.225	0.407	1.81	0.207	170	220	318	22	27	38	88.2%	283	374	530	9	12	15	97.1%	7.50	6.70	7.44	8.1	21							
2017	August	0.218	0.261	1.20	0.292	159	268	288	10	18	23	91.9%	288	403	524	7	11	17	96.8%	7.50	6.80	6.73	8.1	50							
2017	September	0.247	0.540	2.18	0.243	158	360	326	7	9	14	95.8%	276	306	570	5	5	9	98.4%	7.40	7.10	5.76	8.1	55							
2017	October	0.250	0.574	2.29	0.239	154	304	321	12	14	23	92.8%	252	305	527	6	8	13	97.6%	7.30	7.00	5.16	8.0	37							
2017	November	0.215	0.399	1.85	0.215	281	504	504	27	32	48	90.5%	403	483	723	13	18	23	96.8%	8.40	6.70	5.17	7.9	8							
2017	December	0.220	0.349	1.59	0.224	427	648	784	29	37	54	93.1%	369	434	678	10	11	18	97.4%	7.30	7.00	5.26	8.1	20							
2018	January	0.230	0.268	1.17	0.236	422	630	808	37	40	72	91.1%	354	412	677	18	24	36	94.7%	7.50	6.80	6.05	7.8	20							
2018	February	0.262	0.633	2.42	0.258	256	316	560	26	30	56	90.0%	277	395	606	18	21	39	93.6%	7.60	6.50	5.45	8.9	7							
2018	March	0.223	0.410	1.84	0.239	441	680	820	28	36	55	93.3%	642	833	1194	11	12	22	98.1%	7.00	7.80	6.57	8.4	15							
2018	April	0.216	0.288	1.34	0.219	228	422	411	30	39	55	86.6%	344	392	619	15	18	27	95.6%	7.50	7.10	6.32	8.4	5							
2018	May	0.231	0.421	1.83	0.240	275	360	528	26	33	52	90.2%	304	390	585	11	13	22	96.2%	7.40	7.00	7.40	7.2	7	42	47	80	1	3	2	98.0%
2018	June	0.227	0.312	1.38	0.239	521	870	984	56	180	111	88.7%	236	399	447	10	13	19	95.8%	7.60	7.40	6.76	7.0	18	30	36	57	1	3	2	96.5%
SUMMARY 2017-2018		0.230	0.633	1.74	0.238	291	870	554	26	180	50	91.0%	336	833	640	11	24	22	96.5%	7.50	6.99	6.17	8.0	22	36	47	68	1	3	2	97.2%
2018	July	0.217	0.283	1.30	0.213	302	392	546	8	12	15	97.3%	314	397	568	12	15	22	96.2%	7.75	7.30	5.82	6.6	1	37	44	67	0	0	0	99.5%
2018	August	0.239	0.485	2.03	0.258	390	545	777	10	15	21	97.3%	295	372	588	7	8	15	97.4%	7.72	7.52	4.94	5.8	1	37	41	74	0	0	0	99.4%
2018	September	0.243	0.608	2.50	0.263	207	400	420	10	16	21	94.9%	252	299	512	7	8	15	97.1%	7.75	7.64	5.13	7.7	3	35	49	71	0	0	0	99.4%
2018	October	0.229	0.687	3.00	0.222	524	995	1001	15	26	27	97.3%	601	757	1147	8	10	15	98.7%	7.93	7.57	5.04	8.2	1	42	50	80	0	0	0	99.5%
2018	November	0.224	0.456	2.04	0.245	743	1100	1387	33	41	67	95.2%	412	601	769	12	16	25	96.7%	7.86	6.82	5.08	10.1	5	42	49	79	2	6	4	94.9%
2018	December	0.217	0.447	2.06	0.248	429	540	778	37	48	77	90.1%	299	372	542	13	16	27	95.0%	7.70	7.54	5.01	10.0	1	48	62	86	12	15	25	71.5%
2019	January	0.222	0.351	1.58	0.234	462	800	856	47	52	92	89.2%	343	487	635	18	21	36	94.3%	7.55	7.29	4.98	11.7	4	40	46	74	2	6	4	95.2%
2019	February	0.268	0.545	2.03	0.320	565	1050	1263	54	70	145	88.5%	1068	2029	2389	17	20	45	98.1%	7.51	7.23	4.81	11.0	5	36	48	81	4	7	11	85.9%
2019	March	0.227	0.687	3.03	0.241	221	288	418	34	42	68	83.6%	315	344	595	15	19	29	95.1%	7.83	7.43	4.95	10.3	7	42	46	80	1	3	2	97.2%
2019	April	0.227	0.548	2.41	0.253	281	444	532	26	0	54	89.8%	341	409	646	18	37	38	94.2%	8.42	7.75	6.62	7.2	8	44	48	84	12	21	25	69.9%
2019	May	0.231	0.314	1.36	0.243	258	394	498	19	27	39	92.2%	615	823	1184	8	12	16	98.7%	8.15	7.26	6.18	7.5	33	37	41	70	0	0	0	99.4%
2019	June	0.255	0.485	1.90	0.280	308	658	654	13	32	30	95.4%	250	555	532	6	8	15	97.3%	7.87	7.54	5.82	7.6	6	30	34	64	0	0	0	99.3%
SUMMARY 2018-2019		0.233	0.687	2.10	0.252	391	1100	761	25	70	55	92.6%	425	2029	842	12	37	25	96.6%	7.84	7.41	5.36	8.6	6	39	62	67	3	21	6	92.6%
2019	July	0.231	0.278	1.20	0.219	205	268	395	13	41	25	93.8%	306	414	591	6	8	11	98.1%	8.05	7.00	5.77	7.0	1	35	38	68	0	0	0	99.3%
2019	August	0.245	0.388	1.58	0.257	228	392	465	8	10	17	96.4%	234	318	477	5	5	10	98.0%	7.58	7.18	6.11	7.0	1	37	40	75	0	0	1	99.1%
2019	September	0.232	0.277	1.19	0.223	148	262	287	15	21	27	90.6%	240	277	464	7	9	12	97.4%	8.01	7.41	7.23	6.4	6	37	43	71	0	0	0	99.3%
2019	October	0.248	0.432	1.74	0.242	167	300	345	13	16	27	92.2%	244	316	504	5	7	11	97.9%	8.21	8.00	6.63	7.8	1	32	35	67	0	0	0	99.4%
2019	November	0.231	0.697	3.02	0.235	168	298	323	15	16	30	90.7%	292	358	562	9	13	17	97.0%	8.40	8.11	5.27	11.9	5	38	41	74	1	2	1	98.1%
2019	December	0.230	0.436	1.90	0.237	174	361	334	31	46	61	81.8%	255	385	488	11	16	22	95.6%	8.27	7.61	5.50	11.9	3	37	46	70	0	1	1	99.2%
2020	January	0.225	0.522	2.32	0.237	160	236	300	40	45	79	73.7%	266	361	499	16	20	31	93.9%	7.91	7.37	5.79	12.5	9	39	42	73	0	0	0	99.5%
2020	February	0.241	0.431	1.79	0.245	310	474	623	39	46	80	87.1%	536	684	1079	15	19	31	97.1%	8.23	7.81	6.19	11.3	1	36	43	72	13	17	27	62.8%
2020	March	0.253	0.368	1.46	0.256	240	588	506	43	65	93	81.7%	275	531	579	13	21	28	95.2%	8.79	6.91	5.98	10.2	59	30	40	62	10	19	21	65.7%
2020	April	0.206	0.373	1.81	0.200	156	352	268	25	35	42	84.3%	299	481	513	7	10	12	97.6%	7.27	7.12	5.78	11.0	2	37	39	63	0	0	0	99.5%
2020	May	0.220	0.473	2.15	0.230	414	762	760	24	33	46	93.9%	592	894	1088	8	8	14	98.7%	7.39	7.12	4.90	9.2	16	32	33	58	0	1	1	99.1%
2020	June	0.217	0.430	1.99	0.205	488	652	883	13	18	22	97.5%	315	710	569	7	10	12	97.9%	7.91	7.03	4.32	9.5	1	36	42	66	0	0	0	99.5%
SUMMARY 2019-2020		0.232	0.697	1.85	0.232	238	762	457	23	65	46	88.6%	321	894	618	9	21	17	97.0%	8.00	7.39	5.79	9.7	9	35	46	62	2	19	4	93.4%
AVG (2017-2020)		0.232	0.697	1.90	0.240	307	1100	591	25	180	50	90.7%	361	2029	702	11	37	21	96.7%	8.79	6.50	5.77	9	12	37	62	72	2	21	5	93.4%

Exhibit 4-2
Wastewater Flow Projections
Planning Period 2020-2040

Year	Existing Service Area					0-2 Year Expansion Area No. 1[D] (gpd)	3-10 Year Expansion Area No. 2 (gpd)	11-20 Year Expansion Area No. 3 (gpd)	Avg. Design Flow (gpd)	Peak Design Flow[E] (gpd)
	Population	% Change[A]	No. of Customers	Avg. Flow Per Customer[B] (gpd)	Avg. Wastewater Flow[C] (gpd)					
2020	2,880		1,412	162.6	229,553				249,187	747,561
2021	2,818	-2.17%	1,381	162.6	224,579				224,579	673,736
2022	2,844	0.93%	1,394	162.6	226,698	58,902			285,600	856,800
2023	2,782	-2.24%	1,364	162.6	221,724	58,902	19,634		300,260	900,779
2024	2,719	-2.32%	1,333	162.6	216,749	58,902	39,268		314,919	944,758
2025	2,657	-2.37%	1,302	162.6	211,775	58,902	58,902		329,579	988,737
2026	2,642	-0.57%	1,295	162.6	210,614	58,902	78,536		348,052	1,044,157
2027	2,628	-0.57%	1,288	162.6	209,453	58,902	98,171		366,526	1,099,578
2028	2,613	-0.57%	1,281	162.6	208,293	58,902	98,171		376,755	1,130,266
2029	2,599	-0.58%	1,274	162.6	207,132	58,902	98,171		364,205	1,092,614
2030	2,584	-0.58%	1,267	162.6	205,971	58,902	98,171		363,044	1,089,132
2031	2,567	-0.69%	1,258	162.6	204,589	58,902	98,171	45,561	407,223	1,221,669
2032	2,549	-0.70%	1,250	162.6	203,207	58,902	98,171	56,951	417,231	1,251,693
2033	2,532	-0.70%	1,241	162.6	201,825	58,902	98,171	68,341	427,239	1,281,718
2034	2,515	-0.71%	1,233	162.6	200,443	58,902	98,171	79,732	437,248	1,311,743
2035	2,497	-0.71%	1,224	162.6	199,061	58,902	98,171	91,122	447,256	1,341,767
2036	2,477	-0.85%	1,214	162.6	197,430	58,902	98,171	102,512	457,014	1,371,042
2037	2,457	-0.86%	1,204	162.6	195,798	58,902	98,171	113,902	466,772	1,400,317
2038	2,436	-0.86%	1,194	162.6	194,166	58,902	98,171	125,293	476,531	1,429,592
2039	2,416	-0.87%	1,184	162.6	192,534	58,902	98,171	136,683	486,289	1,458,867
2040	2,395	-0.88%	1,174	162.6	190,902	58,902	98,171	148,073	496,047	1,488,142

Note
[A] It is assumed that growth of the City and the amount served by the City's wastewater facilities will adjust at the same rate as the County.
[B] The Average Flow Per Customer in the existing service area is based on the historical data (July 2017 through June 2020), and includes all customer types (residential, commercial, School/Tax Exempt).
[C] Average WW Flow based on population changes in Existing Service Area.
[D] Accounting for population influx due to Nucor facility coming online.
[E] The Peaking Factor was assumed to be 3.0

Chapter 5
Existing Facilities

A. General

The City of Brandenburg's wastewater collection and treatment system was originally constructed in the early 1960's. The original wastewater treatment plant (WWTP) was built in 1963, rated for a maximum flow of 0.117 MGD, and upgraded in 1980. It consisted of grit removal, a comminutor, a primary clarifier, a rotating biological contactor (RBC) for biological treatment, a final clarifier, a chlorine contact basin, an aerobic digester, and sludge drying beds. Over time, the collection system has expanded outwards from the City's core and in the early 1990's the original WWTP was replaced. The current WWTP is discussed further in Part C of this Chapter.

The purpose of this chapter is to evaluate the capacity, capability and condition of the existing wastewater collection and treatment facilities.

B. Collection System

The Brandenburg wastewater collection system is considered "separate" as opposed to "combined", which means that there are separate pipes dedicated to transporting storm and sanitary flows. The collection system was originally constructed in the early 1960's and encompassed downtown Brandenburg, as well as some areas south of downtown. The original system mostly consisted of gravity sewer as it was able to follow the natural topography sloping towards the Ohio River from south to north. Since that time, the sewer system has expanded to accommodate the City's population growth. Gravity pipe remained the primary form of sewer, but several lift stations and force mains were required as the collection system continued to expand to the south, east, and west through undulating topography. The wastewater collection system within the Planning Area consists of the following components:

1. Wastewater Lift Stations

There are twenty-two (22) wastewater lift stations in Brandenburg. Two of the twenty-two lift stations are privately owned and operated. Two lift stations – Riverport A and Riverport B – used to pump directly to the influent screenings channel at the WWTP. They have recently been eliminated due to the construction of the Nucor facility. All lift stations are summarized in the following table and shown in Exhibit 5-1:

Table 5-1
Brandenburg Wastewater Lift Stations

Lift Station Name	Pump Type	Capacity (gpm)
Michael Lane	Submersible	***
B-Dury Elementary School	Submersible	80**
High Street	Submersible	60**
Brandenburg Bypass	Submersible	***
#2 Better Mobile Living	Submersible	120**
North Main	Submersible	1084
Worley Lane	Submersible	***
Bank Station	Submersible	200**
KFC/Taco Bell/Long John Silvers*	Submersible	***
Donna Drive	Submersible	180**

Table 5-1 Brandenburg Wastewater Lift Stations (Continued)		
Lift Station Name	**Pump Type**	**Capacity (gpm)**
River Bluff Beach Road	Submersible	***
Highway 933	Submersible	200**
Lisa Drive	Submersible	25**
Bypass Pumping Station	Submersible	***
School Side Drive	Submersible	***
Lusk Lane	Submersible	***
#3 Better Mobile Living	Submersible	120**
2 Pump Station 1692	Submersible	25**
Middle School	Submersible	200**
High School*	Submersible	***
HWY 170	Submersible	731**
Fair Grounds Road	Submersible	80**

*Privately owned and operated pump stations.
**Capacity provided by the Lincoln Trail ADD.
***Capacity unknown due to pumps being rebuilt and impellers modified.

The North Main Lift Station is the largest of the City's wastewater lift stations with four pumps ranging between 250 and 575 GPM. It is located off River Road in Brandenburg's Waterfront Park. The pump station was constructed in 1993 with the construction of the new WWTP.

In addition to the lift stations, there are approximately fifteen (15) private grinder pumps within the wastewater collection system. The applications for the grinder pumps include residential, commercial, industrial, institutional, and other.

2. Gravity Sewers

The wastewater collection system consists of approximately 130,500 linear feet of gravity sewer line. The following tables give a summary of the collection system broken down by pipe diameter and pipe material. A map of the system is presented in Exhibit 5-1. The gravity sewer sizes and lengths were provided by the Lincoln Trail ADD.

Table 5-2 Brandenburg Collection System Pipe Diameter Summary		
Pipe Diameter (in)	**Length (LF)**	**% of Total Length**
8	121,905	93.4%
10	8,572	6.6%
Total Length	**130,477**	**100%**

Table 5-3 Brandenburg Collection System Pipe Material Summary		
Pipe Material	**Length (LF)**	**% of Total Length**
PVC	79,144	60.7%
VCP	51,333	39.3%
Total Length	**130,477**	**100%**

3. Septic Systems

The Planning area currently has five residential areas that are serviced by septic systems:

Table 5-4 Residential Areas within Planning Area that are on Septic Systems	
Residential Area	**Approx. # of Septic Tanks**
Four Oaks Road	22
Quail Run Road	56
Knollwood Road	27
River Edge Drive	21
Windsor Place	31
Sun Valley Road	30

Table 5-4 Residential Areas within Planning Area that are on Septic Systems (Continued)	
Bud Wilson Road	37
Christian Church Road	25
Moremen Road	3

4. Collection System Condition

In general, the physical condition of the existing collection system, including gravity sewer lines and lift stations, allows the system to perform well during dry and wet weather.

The existing lift stations mentioned are all generally in good condition and are able to operate sufficiently. The North Main lift station is the largest lift station. It pumps the entire collection system to the WWTP. The existing equipment, controls, and structural elements are generally in good condition. The lift station is located within the 100-year flood plain. The controls for the pumps are located at the retired WWTP, which is above the 100-year flood plain. The City would like to move the controls out from the retired WWTP onto a platform to make them more accessible.

The Middle School lift station is a duplex lift station with submersible pumps, wet wells, controls, and valve vaults. The valve vault was replaced in 2009. The hatch over the wet well and control panels needs to be replaced. The City would potentially like to increase the capacity of the lift station. A hydraulic model wasn't complete for this Facilities Plan. A model would need to be completed to assess the capacity of the existing lift station and make recommendations to increase the capacity.

Many of the gravity sewers in the collection system are aged and approaching 50-60 years in service (specifically downtown). Also, roughly forty percent (40%) were constructed of vitrified clay pipe. Based on the calculations completed in Chapter 4, the City isn't required to complete a sanitary sewer study. However, based on the age and material of the majority of the collection system, it would be recommended that the City establish a CCTV program to review the existing collection system. As previously mentioned, a hydraulic model wasn't completed for the collection system. A hydraulic model would help establish capacity issues that exist with the system. In addition to CCTV identifying the areas that would potentially need to be replaced or rehabilitated, the model would be useful in establishing which sewers require upsizing.

Inflow and infiltration into the collection system was previously discussed in section F of Chapter 4. The City doesn't currently have any known sanitary sewer overflow locations.

C. __Brandenburg Wastewater Treatment Plant__

1. General

The existing Brandenburg WWTP is located on Buttermilk Falls Road east of downtown Brandenburg. The plant outfall is located near National Hydrography Dataset (NHD) mile point 643.3 of the Ohio River, segment 08217.

The treatment plant was originally constructed in 1993. It has a rated capacity of 0.312 MGD average daily flow (ADF) and 0.932 MGD peak flow. The Brandenburg WWTP replaced the existing treatment facility located on River Road. The "old" treatment plant was originally constructed in 1963 with a capacity of 0.19 MGD. It remained in operation until the completion of the existing treatment plant, and was retired once it reached the end of its design life in 1993. Currently all wastewater flow is pumped and treated at the "new" WWTP.

The existing facility consists of the North Main influent lift station, influent flow metering via magnetic flow meter (a.k.a "mag meter"), a mechanical inline screen along with a manual bypass bar rack, two (2) facultative lagoons, two (2) secondary clarifiers, disinfection with Peracetic Acid (PAA), effluent flow measurement via Parshall Flume, and a return activated sludge (RAS) pump station. A schematic diagram of the existing plant is shown in Exhibit 5-2.

A copy of the current KPDES Permit is located in Appendix C.

2. Plant Capacity

According to the 1993 Operation and Maintenance Manual, the Brandenburg WWTP has the following design capacity:

Table 5-5 Brandenburg WWTP Current Design Capacity	
Design Population	3,496
Influent BOD_5 Loading	870 lbs/day
Influent TSS Loading	840 lbs/day
Influent Ammonia-Nitrogen Loading	70 lbs/day
Average Daily Flow (ADF)	0.312 MGD
Peak Hydraulic Flow (PHF)	0.932 MGD

As can be seen in Exhibit 4-1, the influent loadings have averaged 702 lbs BOD_5/day and 591 lbs TSS/day, respectively, over the past three years (July 2017 through June 2020). The averages for both influent BOD_5 and TSS loading were below the design capacity. However, there were six months over the past three years where the average monthly influent TSS loading exceed the design capacity. The average monthly influent BOD_5 loading had six months exceeding the design capacity. This has stressed the plant and resulted in periodic discharge limit violations as well as an Agreed Order (see discussion in Chapter 5, Section F, Part 2).

3. On-Site Storm Water Management

The Brandenburg WWTP is outside the 100-year floodplain of both the Ohio River and Flippins Run. Additionally, the majority of WWTP site is grass and the treatment processes are open to the atmosphere. Based on the site layout, the on-site storm water management is minimum. There is one culvert located beneath the access drive and a drainage ditch along the access drive to the south of site. The access drainage ditch ties into a drainage ditch along the south side of the plant site and drains to the west towards Flippins Run.

4. Influent Lift Stations

Since the recent elimination of Riverports A and B, the North Main Lift Station is now the sole location where raw wastewater from the Brandenburg Collection System is pumped to the WWTP. The North Main Lift Station is comprised of two duplex lift stations. An upstream manhole diverts the flow to either duplex lift station, which tie into the same discharge header and then to the head of the WWTP. The north duplex lift station was originally designed with one submersible pump capable of pumping 731 GPM at 78 feet of total dynamic head (TDH), and a second submersible pump capable of pumping 400 GPM at 60 feet TDH. The south duplex lift station was originally designed with one submersible pump capable of pumping 400 GPM at 58 feet of total dynamic head (TDH), and a second submersible pump capable of pumping 100 GPM at 58 feet TDH.

The four pumps within the North Main Lift Station have been modified since the station's original construction, altering the flow rate of each pump. The 731 and 400 GPM pumps within the north duplex lift station now have flow rates of 575 and 429 GPM, respectively. The 400 and 100 GPM pumps within the south duplex lift station now have flow rates of 509 and 250 GPM, respectively.

The raw wastewater is pumped through a 10-inch PVC force main, approximately 5,110 feet to the WWTP that lies to the east. The lift station and force main were both built with the existing Brandenburg WWTP circa 1993.

Based on the 1993 O&M manual, for normal operation for water level rising, the initial pump control settings are as follows:

Table 5-6
North Main Lift Station
Initial Control Settings
Water Level Rising

Elevation	Wet Well Depth (ft)	Action
412.75	5.75	Pump No. 4 Starts
413.19	6.19	Pump No. 2 Starts Pump No.4 Stops

Table 5-6 North Main Lift Station Initial Control Settings Water Level Rising (Continued)		
413.69	6.69	Pump No. 3 Starts
414.36	7.36	Pump No. 2 and 3 Stop Pump No. 1 and 4 Start
419.25	12.25	All Pumps Stop

Pump No. 1: 575 GPM
Pump No. 2: 429 GPM
Pump No. 3: 509 GPM
Pump No. 4: 250 GPM

Based on the 1993 O&M manual, for normal operation for water level falling, the initial pump control settings are as follows:

Table 5-7 North Main Lift Station Initial Control Settings Water Level Falling		
Elevation	**Wet Well Depth (ft)**	**Action**
418.25	11.25	All pumps reset
410.25	3.25	Pump No. 1,2, and 3 Stop
410.00	3.00	Pump No. 4 Stops

Pump No. 1: 575 GPM
Pump No. 2: 429 GPM
Pump No. 3: 509 GPM
Pump No. 4: 250 GPM

Two former lift stations, Riverport A and Riverport B, were built to serve industry development northeast of the WWTP along the Ohio River. Each station pumped raw wastewater through separate 6-inch PVC force mains to the WWTP. These two Lift Stations are no longer in service due to the construction of the Nucor facility.

The existing North Main Lift Station has sufficient pumping capacity to adequately transport the projected 2040 average daily flow of 0.500 MGD. It does not, however, have the capacity to pump the projected 2040 peak hydraulic flow of 1.500 MGD with one pump out of service. It is assumed that all of the City's projected flow will be conveyed through the North Main Lift Station. Chapter 7 of this Facilities Plan identifies recommendations for pump sizing and capacity at the North Main Lift Station.

5. Raw Wastewater Flow Measurement

The raw wastewater flow is measured with a magnetic flow meter in a manhole west of the screening chamber. The manhole appears in satisfactory condition and the mag meter was replaced in 2010.

6. Pretreatment

a. Mechanical Inline Screen/Compactor

The plant originally contained a mechanically-cleaned bar screen capable of handling a peak flow of 1.011 MGD. The screen was designed to remove large solids and stringy material from the influent, and consisted of a bar rack with ½-inch openings between bars and cleaning rakes.

The mechanically-cleaned bar screen was replaced in 2010 with a mechanical inline screen/compactor. The screen/compactor was designed to start/stop on the influent channel level. The current installation uses a float installed upstream of the screen/compactor for start/stop signals. The mechanical inline screen/compactor is a rotating auger with peak flow capacity of 1.1 MGD. The rotating auger has a spiral lifting screw with perforated screens. The spiral lifting screw removes solids to a garbage bin while soft organics are washed back into the channel through the perforated screens. The mechanical inline screen/compactor is performing adequately.

b. Manually-Cleaned Bar Rack

The manually-cleaned bar rack serves as an emergency bypass. The manual bar rack is located in a parallel channel with the inline mechanical inline screen/compactor in the screening chamber. An opening in the concrete wall splitting the two channels has a stainless steel overflow weir plate. When the influent flow exceeds the capacity of the mechanical bar rack channel, the flow crests over the weir plate and enters the manually-cleaned bar rack channel. The manual bar rack consists of aluminum bars spaced 1-inch apart and is cleaned by hand. Since the bar racks are manually cleaned, the cleaning process is cumbersome and labor intensive. The manual bar screen has been in service for approximately 25 years, but appears to be in good condition.

c. Screening Chamber

The screening chamber has a design capacity of 0.312 MGD average daily and 0.932 MGD peak hydraulic flow. The City reports, however, that when a combination of influent pumps turn on it creates a burping affect. This occasionally results in the influent flow overtopping the weir and flowing through the manual bar screen. The frequency of the flow overtopping the weir plate has led to solids reaching the lagoons that would normally be removed by the mechanical inline screen/compactor.

The screening chamber has a 24" x 34" channel gate within the mechanical inline screen/compactor channel, which allows for maintenance. The screening chamber and channel gate have been in service for approximately 25 years. The concrete of the screening chamber has started to show wear, and some of the aluminum grating over portions of the channel have been removed.

7. Screen Effluent - Box No. 1

Raw wastewater flows from the screening chamber into Screen Effluent Box No. 1, which distributes flow to the two (2) existing lagoon cells and receives return activated sludge (RAS) from the scum/sludge/dewatering pump station. The box contains a concrete wall splitting the box into two cells, one for each existing lagoon, as well as a stop gate. The stop gate controls flow by blocking all flow to one of cells. During normal operation, the stop gate will be installed to block all flow to Box No. 2 just upstream of Lagoon Cell No. 2. If Lagoon Cell No. 1 requires maintenance, the stop gate will be installed to block all flow to Lagoon Cell No. 1 and diverted to Box No. 2. Box No. 1 has been in service approximately 25 years. The portion of concrete box that brings flow to Lagoon No. 1 has begun to show wear due to the influent raw wastewater. Other portions of the concrete structure appear to be in satisfactory condition. The stop gates and gate guides appear to be in satisfactory condition, as well.

8. Facultative Lagoons

The Brandenburg WWTP has two (2) existing facultative lagoons for the purpose of biological treatment. The facultative lagoons utilize both aerobic and anaerobic treatment processes for organic removal. During normal operation, raw wastewater enters Lagoon Cell No. 1, where it is partially aerated by four floating aerators operating on timers. The treated wastewater is discharged to Box No. 2. Within Box No. 2, the flow will be diverted to Lagoon Cell No. 2. The wastewater will undergo the same treatment process as Lagoon Cell No. 1. The Lagoon Cell No. 2 effluent discharges to the Chlorination Induction Station. When maintenance is required, Lagoon Cell No. 1 or 2 can be bypassed using the stop gates within Box Nos. 1 and 2.

Each facultative lagoon cell is approximately 246'-0" x 246'-0" with a normal depth of 17'-6". The total volume of the two lagoons is approximately eight million gallons. The hydraulic retention time within each cell is 10 days. The lagoons are divided into three zones: aerobic, quiescent, and anaerobic. The aerobic zone is the upper zone.

The approximate volume of this zone is 3.16 million gallons per cell and makes up the top 11.5 feet of each. This zone supports aerobic bacteria converting wastes to carbon dioxide, ammonia, and phosphates. The middle zone is the quiescent zone. The approximate volume of this zone is 0.49 million gallons per cell and three feet deep. This zone allows solids to settle. The anaerobic zone is at the bottom of each cell. The approximate volume of this zone is 0.374 million gallons per cell, and consists if the bottom three feet of the lagoons. The settled solids from the quiescent zone are decomposed within this zone.

The lagoon lining is from the original plant construction in 1993 and is showing signs of wear and tear. There are a number of spot repairs, as well as signs of settlement on the slopes of the lagoons. Also, Lagoon Cell No. 1 often times contains numerous large solids (i.e. wrappers) that would have normally been captured by the mechanical inline screen/compactor. Instead, these solids have been able to pass through the manual bar screen during periods when the mechanical inline screen/compactor has been down for repairs.

During down times, the flow is diverted through the manual bar screen.

Routine maintenance is required on this type of treatment process to control the sludge build-up on the bottom of the lagoons. Sludge build-up can lead to higher TSS, BOD_5, and ammonia effluent levels. According to the 1993 O&M Manual, the facultative lagoons have a 20-year design period. The existing lagoons have been in operation for 25+ years and have not been dredged during that time. As previously mentioned, the WWTP has experienced months where the influent BOD_5 and TSS loadings exceed the design capacity of the WWTP. This has contributed to the sludge accumulating within the lagoons more quickly than originally designed. Dredging the two lagoons can help reduce the high effluent TSS, BOD_5, and ammonia levels that have resulted in permit violations. An example of sludge accumulation mapping is included as Appendix M for a survey performed on May 3, 2017.

Each cell has four (4) 15 HP floating aerators that provide mixing and oxygen to activated sludge in the upper portions of the lagoons. The aerators operate on 24-hour timers to control the dissolved oxygen concentration within the aerobic zone. The timers are manually adjusted by the operator based DO readings during their weekly samples. The original eight (8) floating aerators have recently been replace with new floating aerators. The eight aerators were replaced between June 2014 and June 2016.

9. Lagoon Cell No. 1 Effluent – Box No. 2

Lagoon Cell No. 1 Effluent – Box No. 2 is located in between Lagoon Cell No. 1 and 2. Box No. 2 can distribute the wastewater flow in a number of directions depending on how the plant is currently being operated. The box has four slots for stop gates to direct the flow as the plant operator desires. During normal operation, effluent from Lagoon Cell No. 1 will be directed to Lagoon Cell No. 2. Three stop gates will be arranged in Box No. 2 to prevent flow from going to the Chlorine Induction Station, as well as to prevent any flow coming in from Box No. 1.

If Lagoon Cell No. 1 is offline, effluent from Box No. 1 will be diverted to Lagoon Cell No. 2. In that scenario, stop gates will be arranged in Box No. 1 and 2 to prevent flow from going to both the Chlorine Induction Station and Lagoon Cell No. 1. If Lagoon Cell No. 2 is offline, effluent from Lagoon Cell No. 1 will be directed to the Chlorine Induction Station. The three stop gates will be arranged in Box No. 2 to prevent flow going to Lagoon Cell No. 2, as well as to prevent any flow coming in Box No. 1. Box No. 2 was constructed in 1993.

10. Disinfection Facilities

Disinfection at the Brandenburg WWTP is accomplished using PAA. A pilot study was conducted in May 2017 to determine the efficacy of PAA as a disinfectant for Brandenburg. Based on the results of the study and with a modified NPDES permit approved, in October 2019, the Brandenburg WWTP officially replaced the existing chlorination and de-chlorination disinfection system with a Peracetic Acid (PAA) disinfection system. The permit modification became effective December 1, 2019. The permit expiration date of January 31, 2021 did not change. Disinfection of plant flow is accomplished with the PAA being introduced to the wastewater stream via a pump skid that delivers PAA to a manhole adjacent to the abandoned chlorination/dechlorination structure.

The existing Chlorine Storage Facility, Chlorinators, and Chlorination Induction Station are no longer in service.

11. Clarifier Influent – Box No. 3

Effluent from the former Chlorination Induction Station flows through Clarifier Influent – Box No. 3 to the two (2) secondary clarifiers. Box No. 3 contains a concrete wall splitting the structure into two cells, one for each existing clarifier, as well as a spot for a stop gate. The stop gate controls flow by blocking all flow to one of clarifiers. During normal operation no stop gate is installed, allowing effluent to be evenly distributed to both clarifiers. If either clarifier needs to be bypassed for maintenance, the stop gate will be installed and all effluent to that clarifier will be blocked. Box No. 3 was constructed in 1993.

12. Clarifiers

The effluent from Box No. 3 is gravity fed to the east and west clarifiers. The two secondary center-feed clarifiers are 36-foot diameter and have a 12-foot side water depth. Each have two scraper arms and one skimmer arm. The settled effluent flows out of the clarifier's v-notch weirs and weir troughs to Box No. 4. The skimmer arm rotates on the surface of the clarifiers to remove scum from the surface to the scum box. The two scraper arms rotate on the bottom of the clarifiers to push sludge to the center of the structure. The scum and sludge both flow to the decant manhole.

The two clarifiers were constructed with the original WWTP construction in 1993. The west clarifier has the original drive unit. The east clarifier's drive unit was replaced in 2014. Water leaks around the v-notch weirs in both clarifiers.

The existing clarifiers have a total surface area of 2,036 ft^2. This results in an average overflow rate of 154 gpd/ft^2 at the current average design flow of 0.312 MGD, and a peak overflow rate of 458 gpd/ft^2 at the current peak hydraulic flow of 0.932 MGD. This is below the Ten States Standards design criteria of 1,000 gpd/ft^2 under peak conditions.

13. Decant Manhole

The decant manhole was constructed with the original WWTP in 1993. The scum and sludge from the east and west clarifiers flow through the decant manhole to the Scum/Sludge/Dewater Pump Station. The scum from the east and west clarifiers tee together between the two structures and gravity feed into the decant manhole through a 6-inch pipe. The sludge effluent from each clarifier flows into the decant manhole from two separate 8-inch gravity pipes. The sludge flow from the clarifiers is controlled by two telescoping valves located in the decant manhole.

14. Scum/Sludge/Dewater Pump Station

The scum and sludge mixture (return activated sludge) enters the Scum/Sludge/Dewater Pump Station concrete wet well through an 8-inch gravity sewer fed by the decant manhole. The return activated sludge (RAS) is pumped through the valve vault to Box No. 1, and then into the lagoon cells, initiating the secondary biological treatment process.

The pump station is made up of two separate concrete structures: wet well and valve vault. The wet well is 8-foot diameter, 26.5-foot deep concrete structure with two submersible pumps, each with a rated capacity of 180 GPM (0.26 MGD). Each pump has a 3 horsepower motor and discharges through a 6-inch force main to the valve vault. The vault valve is 6-foot diameter, 4.5-foot deep with two check and gate valves. The two pump discharge force mains tie together with a wye within the valve vault. The single force main then pumps to Box No. 1.

Ten States Standards recommends that RAS pumping capacity be provided to pump between 50% and 150% of the average design flow (ADF). Based on the design pumping conditions, the existing pumps produce 180 gpm (0.26 MGD) with one pump running, which is 112% of the ADF. With both pumps running, the RAS pumping capacity is 360 gpm (0.52 MGD), which is 223% of the ADF. Therefore, the existing RAS facility still has the capacity to meet the recommended Ten States Standards criteria at the current design flow.

The Scum/Sludge/Dewater Pump Station was constructed in 1993 and the concrete structure still appears to be in generally good condition. The pumps and valves all appear in good condition, as well. The pump control panel has some hydrogen sulfide damage.

Based on the 1993 O&M manual, the pump station control settings for normal operation are as shown in Table 5-7.

Table 5-7
Scum/Sludge/Dewater Pump Station Control Settings

Elevation	Wet Well Depth (ft)	Lead	Lag
446.00*	6	ON	ON
445.50	5.5	ON	ON
445.00	5	ON	OFF
443.00	3	OFF	OFF

* High level alarm

According to the City Staff, however, the pumps run full-time.

15. Clarifier Effluent – Box No. 4

Effluent from the east and west Clarifiers flows through Final Clarifier/Contact Basin Effluent – Box No. 4 to the Dechlorination Induction Station. Box No. 4 contains a concrete wall splitting the box into two cells, one for each existing clarifier, and a stop gate. The stop gate controls flow by blocking all flow from one of the clarifiers. During normal operation, no stop gate is installed allowing effluent from both clarifiers to the Dechlorination Induction Station. If flow from either clarifier needs to be stopped, the gate will be installed and all effluent from that clarifier will be blocked. Box No. 4 was constructed in 1993.

16. Dechlorination Facilities

As noted, in May 2017 Brandenburg WWTP conducted a pilot study using PAA and in October 2019 officially discontinued the use of chlorination and dechlorination for disinfection and converted their disinfection system to PAA. PAA does not have any residual maintenance requirements and therefore requires no inactivation. For that reason the chlorine deactivation equipment and facilities has been abandoned.

The Sulfur Dioxide Storage Facility, Sulfonator, and Dechlorination Induction Station are no longer in service.

17. Plant Effluent Flow Measurement

The discharge from the Dechlorination Induction Station passes through a Parshall Flume prior to flowing to the outfall. The Parshall Flume has a 6-inch throat width and is used to measure the plant effluent flow rate. The flume was installed during the original plant construction in 1993. The concrete structure containing the Parshall Flume appears to be in satisfactory condition. The transponder and parshall flume were both replaced in 2017.

18. Outfall

The treated wastewater from the Brandenburg WWTP flows through a 15-inch gravity sewer approximately 2,200 LF to its outfall on the Ohio River. The outfall is a concrete headwall with flow dispersal pier and rip rap. The flow dispersal pier acts as an energy dissipator and the rip rap reduces erosion from the effluent flow. The outfall was installed during the original plant construction in 1993.

19. Automatic Samplers

The plant has two (2) stationary refrigerated automatics samplers, each located where the process flow is to be sampled.

The stationary automatic samplers are installed at the following locations:

a. Screening Chamber (Plant Influent)

b. Parshall Flume (Plant Effluent)

The influent and effluent automatic samplers were replaced in 2011 and 2013, respectively, both appear to be in satisfactory condition.

20. Control Building and Plant Site

The Brandenburg WWTP Control Building was constructed along with the original plant. It has an office, a laboratory, mechanical room, lavatory, and garage. Additionally, just northwest of the Control Building, is a small sump pump station that pumps any wastewater from the Control Building. The force main pumps into the south wall of the screening channel just below the now abandoned Riverport force main. The roof on the Control Building has been replaced within the past 10 years, but some of the interior ceilings tiles appear to have water damage and should be replaced. The plant control panel no longer works and the laboratory is not used as all plant sampling is now performed by a contract laboratory. The building also requires new exterior lights. The sump pump station appears to be in satisfactory condition and the pumps were recently replaced in 2012.

The WWTP was originally accessed on the south side from Buttermilk Farms Road. Buttermilk Farms Road has recently been converted to a pedestrian path. As a result, the City has installed a new access gate on the north side of the WWTP site, as well as a temporary gravel road from the north gate to the existing drive. The existing plant has site lighting, however it is no longer operational.

20. Biosolids Processing and Disposal

Biosolids (sludge) are created in the plants two (2) lagoons and two (2) final clarifiers. The solids from raw wastewater settle to the bottom of the lagoons creating a sludge layer. Biosolids that don't settle within the lagoons will settle to the bottom of the clarifiers, while clear effluent flows from the surface into the clarifier effluent channel and onto disinfection. The sludge from the bottom of the clarifiers is returned as RAS (Return Activated Sludge) to Box No. 1 for use as biological treatment. The plant doesn't waste any sludge. The lagoons of Brandenburg's WWTP are designed to store sludge for a 20 year design period. It has been approximately 25 years since the lagoons have been in operation and they have not been cleaned.

D. Operation & Maintenance Procedures

1. Staff

The City of Brandenburg currently has a total staff of four to operate and maintain the wastewater plant and collection system. Two staff members are certified WWTP operators with one of those staff members also being certified for the collection system. A table presenting the operators, their classifications, and their certification numbers is shown below:

**Table 5-9
Brandenburg WWTP and
Collection System Staff**

Name	Cert. No.	Cert. Level
T.J. Hughes*	01520	II
T.J. Hughes**	19382	II
Gary Hardesty*	16469	II

* WWTP Operator
** Collection System Operator

2. Procedures

The Brandenburg staff visit the WWTP daily. The staff will perform a walkthrough of all the WWTP's processes and take note of anything not performing correctly. Anything not performing will be addressed onsite and repaired. The WWTP will then be "washed down." This process requires the staff to hose down the clarifiers to remove any algae buildup within the troughs. The pump hours for all pumps are recorded. This process typically takes approximately 2-3 hours in the morning.

E. Bypasses and Overflows

Bypasses occur when there is excessive flow and a wastewater treatment plant cannot take the hydraulic load. Bypasses only occur in wastewater treatment facilities and are defined as a portion of flow entering the wastewater treatment plant NOT receiving full treatment in a permitted treatment process.

In some collection systems combined sewer overflows (CSOs) were constructed intentionally for the purpose of discharging excess flow in a combined collection system into a receiving stream. A combined system is defined as sanitary sewage and storm-water utilizing the same collection system for transport to a wastewater treatment plant.

An overflow, also known as a Sanitary Sewer Overflow (SSO), occurs when wastewater flow exceeds the capacity of a sanitary only collection system pipes and/or pump stations. The wastewater then backs up through manholes or other points in the system open to the atmosphere. Both bypasses at wastewater plants and overflows in collection systems generally occur during wet weather, when storm water finds its way into the wastewater collection system by inflow and/or infiltration.

The City of Brandenburg has no combined sewers, and therefore has no CSOs. There are currently no documented SSOs within the Brandenburg Collection System.

F. Need for the Project

1. Compliance Status

The Brandenburg WWTP has at times failed to comply with existing KPDES permit limits for BOD_5, TSS, SS% removal, NH_3N, E. Coli and pH, though the plant generally meets effluent limits (a copy of the KPDES permit is located in Appendix

D). As a result of the KDPES permit violations, the City entered into an Agreed Order with KDOW.

2. Agreed Order

The City of Brandenburg entered into an Agreed Order (AO Case No. DOW 150453) with the Commonwealth of Kentucky Energy and Environment Cabinet Division of Enforcement (DENF) in June of 2016. The Agreed Order cited several Notices of Violation that occurred between May 2011 and December 2015, and required the City to implement various remedial measures.

The required remedial measures included: immediate reporting of all spills, bypass discharges, upset condition discharges, and releases of substances which would result in the pollution of the waters of the Commonwealth; proper and regular operation and maintenance of the sewage collection system and WWTP; submit to DENF for review and acceptance, a written Corrective Action Plan (CAP) to bring the facility into compliance with its KPDES permit; and cease all discharges that are degrading the waters of the Commonwealth. The CAP recommended updating the City's Wastewater Facilities Plan and upgrading the WWTP according to the Facilities Plan recommendations. The selected treatment plant alternative from the 2017 Facilities Plan exceeds the requirements for the CAP upgrades. The new WWTP recommended by the 2020 Facilities Plan exceeds those requirements as well.

The CAP also outlined measures taken over the period of time from June 2014 and June 2016 to try to remain in compliance with their KPDES permit. Those included: replacing all 8 aerators, replacing chlorine and sulfur dioxide pumps, new clarifier drive and torque control, and various electrical work.

3. Surface Water Quality

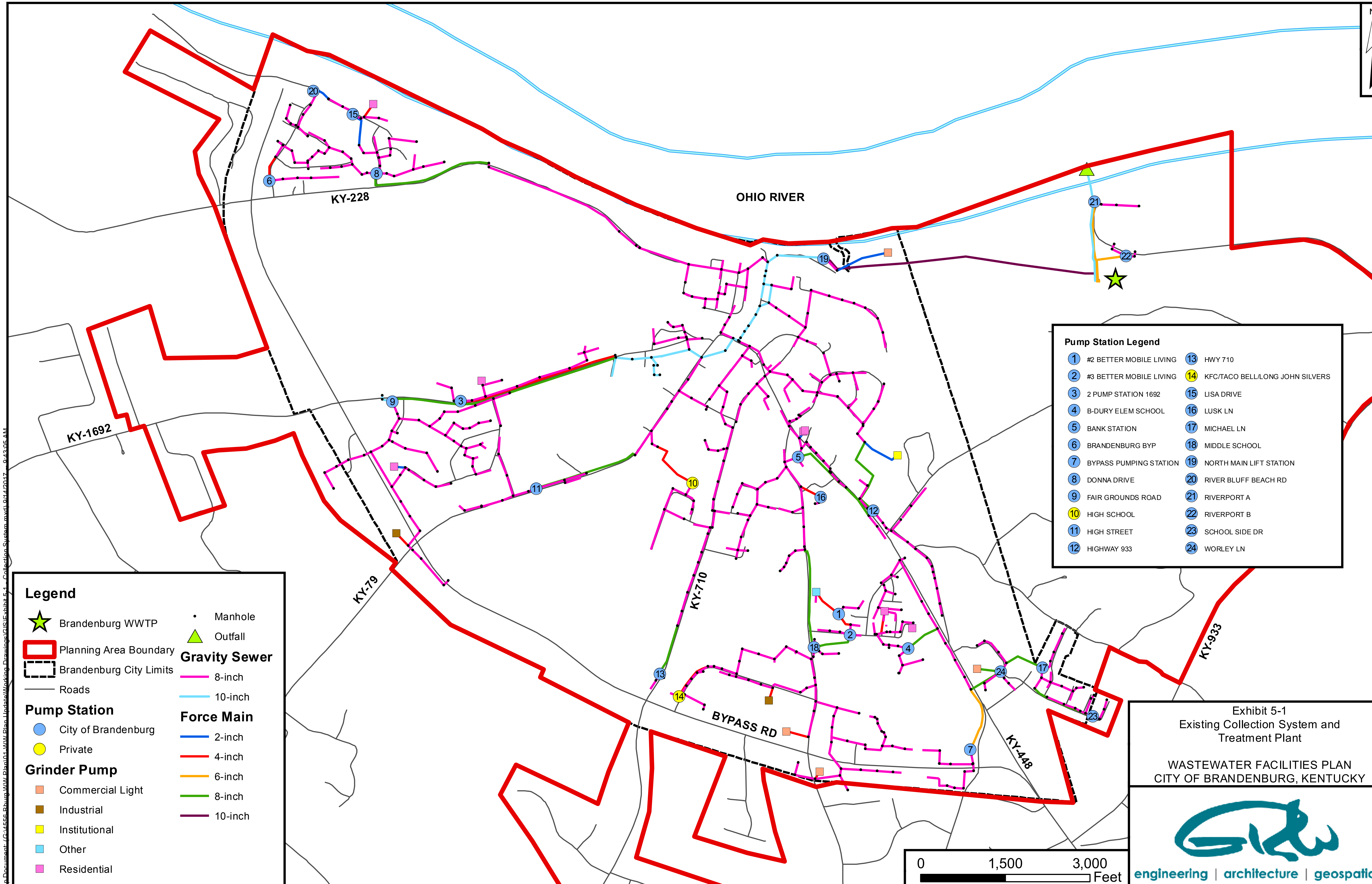
Several stream segments in Meade County (including the Ohio River which is the receiving stream for the WWTP effluent) are listed on the 305(b) Report as impaired, and are found to not support, or only partially support, one or more of their intended uses. See Chapter 2, Section I, Part 5 for a more in-depth discussion of surface water quality.

4. Future Environment without the Proposed Project

A "No-Action" scenario will eventually lead to a negative environmental impact. The existing plant currently receives permit violations. The violations will continue and potentially increase as the WWTP gets older without replacements. The anticipated loading from the ancillary development associated with the addition of the Nucor Corp facility would further exacerbate the negative impacts on the environment without the implementation of the selected treatment alternative.

5. Septic Tanks

There are several existing neighborhoods within the proposed Planning Area that do not have access to sanitary sewer and are on septic tanks. Please see Chapter 2, Section I, Part 10 for a more in-depth discussion of septic tanks, as well as Table 5-4 in this Chapter for a list of the neighborhoods on septic tanks.



OHIO RIVER
KY-228
KY-1692
KY-79
KY-710
BYPASS RD
KY-448
KY-933
N
Pump Station Legend
1 #2 BETTER MOBILE LIVING
2 #3 BETTER MOBILE LIVING
3 2 PUMP STATION 1692
4 B-DURY ELEM SCHOOL
5 BANK STATION
6 BRANDENBURG BYP
7 BYPASS PUMPING STATION
8 DONNA DRIVE
9 FAIR GROUNDS ROAD
10 HIGH SCHOOL
11 HIGH STREET
12 HIGHWAY 933
13 HWY 710
14 KFC/TACO BELL/LONG JOHN SILVERS
15 LISA DRIVE
16 LUSK LN
17 MICHAEL LN
18 MIDDLE SCHOOL
19 NORTH MAIN LIFT STATION
20 RIVER BLUFF BEACH RD
21 RIVERPORT A
22 RIVERPORT B
23 SCHOOL SIDE DR
24 WORLEY LN
Legend
Brandenburg WWTP
Planning Area Boundary
Brandenburg City Limits
Roads
Manhole
Outfall
Gravity Sewer
8-inch
10-inch
Pump Station
City of Brandenburg
Private
Force Main
2-inch
4-inch
6-inch
8-inch
10-inch
Grinder Pump
Commercial Light
Industrial
Institutional
Other
Residential
0 1,500 3,000 Feet
Exhibit 5-1
Existing Collection System and
Treatment Plant
WASTEWATER FACILITIES PLAN
CITY OF BRANDENBURG, KENTUCKY
engineering | architecture | geospatial

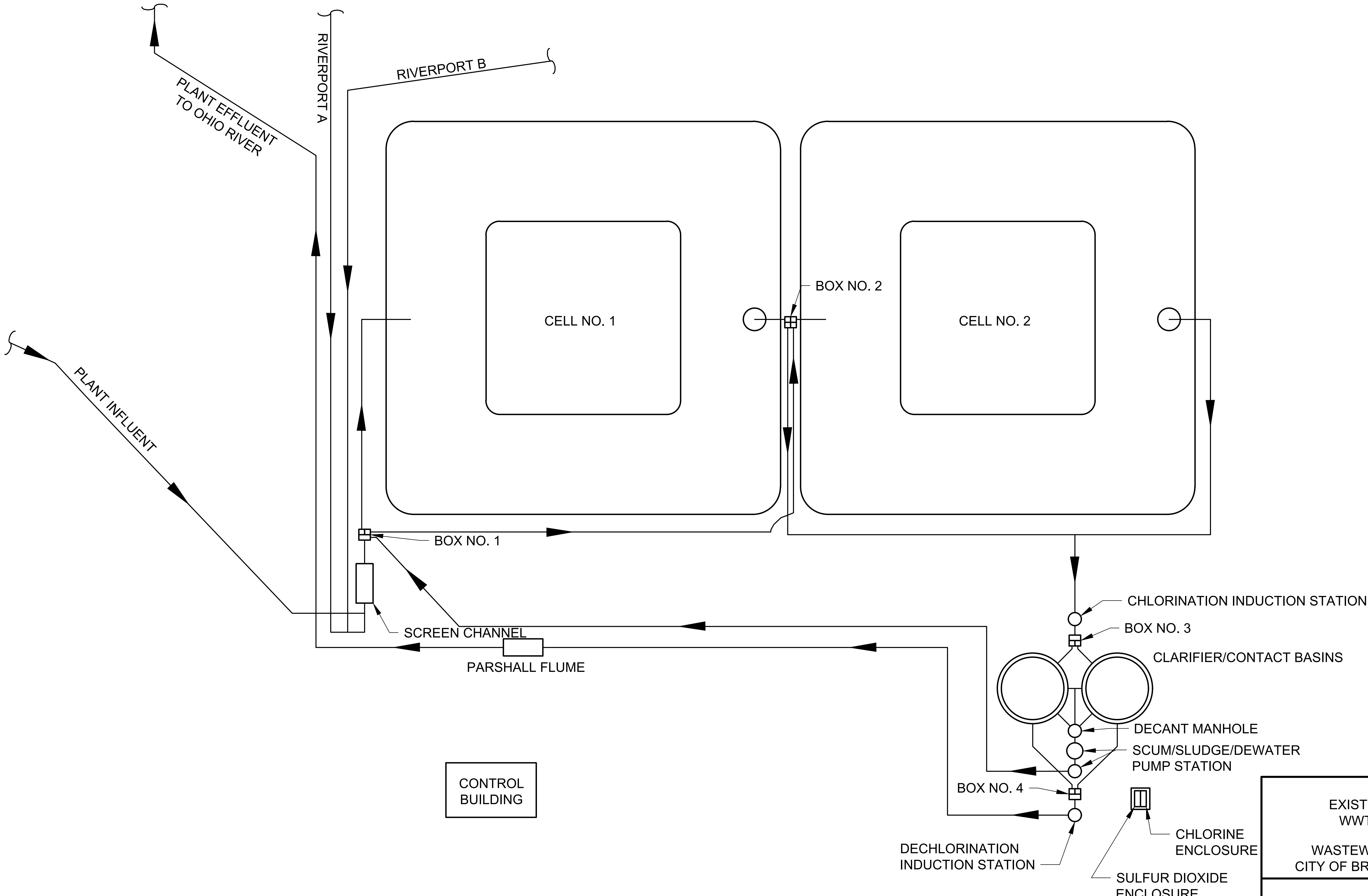


EXHIBIT 5-2
EXISTING BRANDENBURG
WWTP FLOW DIAGRAM

WASTEWATER FACILITIES PLAN
CITY OF BRANDENBURG, KENTUCKY

engineering | architecture | geospatial

Chapter 6
Alternatives

A. *Introduction*

The present worth analysis method was used in evaluating the cost effectiveness of the various alternatives. For the purposes of determining salvage values for structures, equipment, and piping, it was assumed that: structures were 40% of their original value after 20 years, equipment was 0% of its original value after 20 years, and piping was 50% of its original value after 20 years. A discount rate of 2.75% was used in the present worth analysis as set annually by the Department of the Interior's Bureau of Reclamation. This discount rate is used for the period October 1, 2019, through and including September 30, 2020.

Non-monetary effectiveness, including implementability, environmental impact, engineering evaluation, public support and regionalization, was also used in evaluating the alternatives.

Preliminary design calculations that were used in evaluating alternatives are located in Appendix I.

B. *Treatment Alternatives*

The purpose of this section is to define and evaluate the available treatment alternatives for the wastewater treatment plant in order to determine the most environmentally sound, cost effective and readily implementable wastewater treatment system which will meet all applicable federal, state and local requirements for the Brandenburg, Kentucky Planning Area.

As previously mentioned, the City of Brandenburg entered into an Agreed Order to address their numerous permit violations from May 2011 to December 2015. The treatment alternatives evaluated in the following sections were selected to bring Brandenburg's WWTP back into compliance with their KPDES permit limits as well as account for the ancillary growth associated with the new Nucor facility.

1. Influent Design Parameters

Both alternatives will be designed based on the influent parameters listed in Table 6-1.

The current wastewater treatment plant capacity is 0.312 MGD average daily flow (ADF) and 0.932 MGD peak hydraulic flow (PHF). The 2040 design flows are 0.500 MGD ADF and 1.5 MGD PHF.

Table 6-1
2040 Brandenburg WWTP
Influent Design Parameters

Influent Parameter	Value
Average Daily Flow	0.500 MGD
Peak Hydraulic Flow	1.5 MGD
BOD_5	1,685
BOD_5	404
TSS	1,280
TSS	384
Ammonia-Nitrogen	154.3 lbs/day*
Ammonia-Nitrogen	37 mg/l*

*Based on the most recent performance data and projected flows. The City began sampling influent ammonia-nitrogen in May 2018.

The background for the influent design parameters were previously discussed in Chapter 4.

2. Wastewater Treatment Plant Effluent Limits and Reliability Requirements

The Kentucky Division of Water (KDOW) performed a waste load allocation analysis for Brandenburg's WWTP in January of 2020.

The KPDES permit effluent limits and reliability requirements based on the waste load allocation analysis are presented in Appendix D and below Table 6-2.

Table 6-2
Monthly Average KPDES Permit Limits and Reliability Requirements

Effluent Parameter	Value
BOD_5	30 mg/l
TSS	30 mg/l
Ammonia-Nitrogen	20 mg/l
Dissolved Oxygen (min.)	2 mg/l
Total Residual Chlorine	N/A (see Note below) .011 (if used)
Total Nitrogen	Monitor
Total Phosphorus	Monitor
E. Coli	130 mg/l
Reliability Classification	Grade A

NOTE: In May 2017, Brandenburg WWTP replaced the existing chlorination and de-chlorination disinfection system with a Peracetic Acid (PAA) disinfection system. The permit modification became effective December 1, 2019. The permit expiration date of January 31, 2021 did not change. The modified permit is presented in Appendix D.

The selected treatment alternative will be designed to comply with the proposed KPDES effluent limits and reliability requirements. The plant does not currently have limits, but is required to monitor plant effluent for both Total Phosphorus (TP) and Total Nitrogen (TN) in mg/l. Brandenburg's WWTP is not expected to have limits for either nutrient due to the outfall being located on the Ohio River. If the WWTP receives either a TP or TN limit, an adaptation of, or addition to the treatment processes may be required to meet the limit requirements.

3. Treatment Alternatives

Two treatment alternatives, were developed to meet Brandenburg's KPDES effluent limits. An oxidation ditch with secondary clarifiers and solids processing, and a biological treatment lagoon with a polishing reactor were both considered environmentally sound, cost effective, and readily implementable. A third alternative supplied by another design-build firm was not evaluated for this study.

Both treatment alternatives include abandonment of the existing facultative lagoons and completion of a closure plan for the existing plant site.

Additionally, both alternatives have the following treatment processes in common.

Influent Pumping - The existing pumps in the influent pump station are not capable of pumping the projected peak 1.5 MGD to the new plant site with the largest pump out of service. The plan is to replace the existing pumps with Four (4) new submersible pumps that have a 1.5 MGD capacity with the largest pump out of service. A new platform for the pump station generator and electrical equipment will be located above the 100-Year flood plain elevation. Flow measurement will be accomplished with a 10" magnetic flow meter installed in the line to the plant influent.

Screening – New screening/compactor equipment will be placed into a new influent channel. The existing screening equipment will be removed, potentially refurbished, and stored as a back-up. A parallel channel, designed to act as a bypass, will be equipped with a manual bar screen, allowing for removal of the primary channel from service for maintenance. Each channel will be capable of handling the 1.5 MGD peak hourly flow. An existing WWTP sampler will be repurposed.

Disinfection and Post Aeration - The existing Peracetic Acid (PAA) delivery equipment will be used for disinfection. A new chamber will incorporate a dual-sided maze structure that will allow for the removal of one side of the chamber for maintenance. Adjustable fixed weirs at the effluent end of each channel of the contact basin will provide additional capability to adjust contact time.

The effluent from the contact chamber will leave through a common well into the Aeration Chamber constructed as part of the disinfection chamber. Aeration will be achieved through the wastewater fall over the weir exiting the contact chamber. The aeration chamber will include an underflow baffle between the cells to calm flow prior to a V- notch weir for effluent flow measurement. An effluent sample well will also be included with the existing sampler relocated to that location. Effluent will gravity flow through a new line and connect to the existing line with a discharge point in the Ohio River.

Alternative 1 – Oxidation Ditch and Secondary Clarifiers

The Oxidation Ditch and Secondary Clarifiers alternative meets all project goals and objectives and attains the best Non-monetary Effectiveness rating. Elements of the recommended plant upgrades are described below. A further discussion of the new plant upgrade is contained in Chapter 7 – Selected Plan.

In addition to the common processes Alternative 1 includes the following.

Liquid Process Stream

A single grit removal system will be constructed consisting of two concrete structures. Grit is collected in a sump and fluidized with plant potable water then pumped to a grit dewatering box (decanter) in a building adjacent to the system for disposal.

This alternative includes a two ring, series oriented oxidation ditch. The typical flow pattern introduces screened and degritted influent and Return Activated Sludge (RAS) into the outer ring. Manually actuated valves are included to allow the introduction of influent or RAS to the inner ring as desired to provide operational flexibility. A center "island" with a fixed adjustable weir will house a center drain well with an effluent pipe to the secondary clarifiers. A passive recycle using a diversion gate will divert a small portion of flow from the inner ring back to the outer ring to allow for enhanced nitrogen removal. The ditch can be expanded with a third ring in the future. A third ring can double the plant capacity, as well as allow for biological nutrient removal (BNR) of Phosphorus and Nitrogen if future limits are implemented.

Flow from the oxidation ditch is directed to a secondary clarifier influent splitter box. Flow will enter the bottom of the splitter and overflow a weir wall with two (2) manually actuated weir gates to allow flow balancing between the clarifiers or remove a clarifier from service for maintenance.

The system includes two (2) center feed, perimeter withdrawal circular clarifiers. The clarifiers will share a common return activated sludge (RAS)/waste activated sludge (WAS)/drain pump station. A solids removal structure shall be integral to the perimeter of each clarifier with the solids removal rate controlled by an individual telescoping valve. The WWTP will retain "Ten States Standards" with one clarifier out of service at ADF conditions, and PHF conditions with two clarifiers in service.

Effluent from the clarifiers is combined into a common line as input to the disinfection contact chamber, aeration chamber, flow measurement and plant effluent line.

Solids Process Stream

Solids collected by the secondary clarifiers are removed by telescoping valves and piped to a RAS/WAS/Drain pump station. The station will contain three (3) identical VFD pumps. Each pump will be capable of supplying at least 150% of the ADF to the Oxidation Ditch. An RAS magnetic flow meter in a vault will be installed on a common RAS header. Downstream of the common header and upstream of the RAS magnetic flow meter, a force main for the WAS will "tee" off to feed an aerated sludge holding tank with WAS. This station will also serve as a drainage pump station for the oxidation ditch, clarifiers, disinfection basin and other plant structures.

Scum collected from the clarifiers will discharge to a scum pump station with a chopper pump and discharge through a manually activated valve to a dedicated scum line into the aerated solids holding tank.

The aerated solids holding tank provides temporary storage of wasted solids prior to dewatering operations. The basin will provide 4.1 days of storage based on its working volume and allow for five (5) day per week, eight (8) hour per day dewatering while retaining volume to waste on the additional two days. A telescoping weir for decanting will be provided for return to the oxidation ditch influent, and a gravity drain for solids return to the RAS/WAS/Drain pump station. Two (2) positive displacement blowers will supply a coarse bubble aeration system on the tank floor through a discharge header with valves to isolate individual blowers for maintenance.

Settled solids from the aerated solids holding tank will be pumped to the dewatering unit through a variable frequency driven, progressive cavity feed pump. The pump will supply settled solids through a line with a magnetic flow meter with totalizer capability to the system flocculation system. The control system for the dewatering system will provide start, stop, and speed signals for the feed pump.

Dewatering of solids will be accomplished with a fan press. The press will provide operations the ability to dewater five (5) days per week, eight (8) hours per day. The fan press is anticipated to produce a 15% - 18% dry solids dewatered cake product for disposal. Filtrate and press wash water will be pumped to either the influent screen channel or the RAS/WAS/Drain pump station. The dewatering system and cake conveyance system modifications will be installed in an existing Control Building which will be modified to house and facilitate removal of a roll-off for dewatered cake. A truck loading option will be available for loading liquid settled solids from the holding tank in the event of a dewatering equipment outage.

A new skid mounted factory assembled electrical building will be located near the existing control building. The existing site lighting will be replaced, access drive repaved, and a generator will be added.

Exhibit 6-1.1 provides the plant layout and Exhibits 6-1.2 to 6-1.5 provide the financial analysis for Alternative 1.

Alternative 2 – Dual Cell Lagoon and Polishing Reactor

A Dual Cell lagoon and polishing reactor meets all project goals and objectives and attains a lower Net Present Worth, however, it does not achieve the best Non-monetary Effectiveness rating. It lacks the ability to be upgraded or expanded without acquiring additional property. Elements of the recommended plant upgrades are described below. This alternative utilizes one new lagoon located near the existing facility with approximate dimensions of 380'L X 170' W X 17.5'D.

The new lagoon will be divided into two cells using a custom designed hydraulic baffle installed to minimize short-circuiting between each cell. The first cell will be a complete-mix cell. The complete-mix zone of the process is an aerated, aggressively mixed cell that establishes an environment suitable for the rapid removal of BOD5. Retention time in the complete-mix cell is approximately 3.0 days.

In addition to BOD5 removal, ammonia is also removed by the growth of heterotrophic bacteria present in the complete-mix cell. Nitrifying bacteria growth will also occur in the complete-mix cell resulting in additional ammonia nitrification. Aeration and mixing will be provided by diffused, fine bubble aeration.

Following the complete-mix cell, water will pass into the settling cell with a detention time of approximately 9.0 days. This cell is provided with just enough air to maximize solids degradation and prevent odors. Aeration is provided by diffused, fine bubble aeration.

Following the treatment lagoon, a polishing reactor will provide additional BOD and ammonia treatment. The reactor consists of submerged, attached-growth media modules used for maintaining an adequate population of autotrophic bacteria. The reactor enhances the growth of nitrifying bacteria to encourage conversion of ammonia to nitrates in an aerobic environment.

Aeration is provided by rack-mounted coarse-bubble diffusers located under the media, which evenly distributes the air and shears coarse bubbles into very fine bubbles. The reactor produces BOD and TSS effluent levels less than 10 mg/l and NH3-N as low as 1 mg/l. Housed in a concrete structure near the effluent of the pond, the reactor is the final stage of the lagoon based biological treatment process. The approximate size of the reactor is 36'L x 17'W x 12'D.

The oxygen requirements for the lagoon will be met by two (2) 40 HP blowers in continuous operation at the design load with a third blower as a spare. One (1) 7.5 HP blower will be in continuous operation for the polishing reactor, with a second blower as a spare.

Exhibit 6-2.1 provides the plant layout and Exhibits 6-2.2 to 6-2.5 provide the financial analysis for Alternative 2.

No Action

As previously mentioned, the City of Brandenburg entered into an Agreed Order with the Common of Kentucky Energy and Environment Cabinet Division of Enforcement in June 2016 due to permit valuations from May 2011 to December 2015. One of the remedial measures within the Agreed Order was for the City to submit a CAP to the DENF. The CAP recommended updating wastewater treatment operations in accordance with the recommendations made within the updated Facilities Plan. For these reasons, a "No Action" alternative isn't acceptable and was eliminated from consideration.

Preferred Biological Treatment Alternative

The Oxidation Ditch technology was preferred by the City of Brandenburg based on its flexibility, and process equipment redundancy. Additionally, Alternative 1 allows for expansion of the plant capacity, or regionalization, without the need for acquisition of additional property surrounding the site.

4. Cost Effective Analysis

The present worth value method was used to determine the most cost effective alternatives. Initial capital costs, O&M costs and salvage values were used to calculate the present worth value.

Although Alternative 1 presents the higher Net Present Worth it provides the best Non-Monetary Effectiveness rating. The results of the cost effective analysis for the two biological treatment alternatives considered are illustrated in Exhibit 6-3.

C. <u>Sustainable Design</u>

The industry standard for determining the sustainable or "green" attributes of a given design is the Leadership in Energy and Environmental Design (LEED) Certification Process, as put forth by the United States Green Building Council (USGBC). All projects should involve efficient use of energy as part of the basic design, regardless of whether or not the owner is looking to have it officially LEED certified. In the case of new treatment plants, there are numerous opportunities to design energy efficient equipment and processes.

The LEED rating systems are based on accepted energy and environmental principles that strike a balance between known established practices and emerging concepts. These emerging concepts are organized into five environmental categories plus a "bonus" innovative design category. The five basic categories include: sustainable sites, water efficiency, energy and atmosphere, materials resources, and indoor environment quality.

Some "green" design features that are applicable to a wastewater treatment plant site might include variable frequency drives (VFDs) on equipment such as pumps and aerators, energy efficient lighting, rain gardens and infiltration swales to help both clean and slow down storm water, pervious pavement or permeable pavers to reduce impervious surface area, cisterns to store water for irrigation purposes, restoration of native grasses and wildflowers to limit the need for watering and for erosion control, and the re-establishing or enhancement of stream riparian buffers.

More ambitious projects could involve "green" elements such as vegetated roofs to reduce heat island effect and increase energy efficiency, or turbines at the bottom of the cascade aeration steps to produce electricity for use at the plant or for sale back to the power provider.

D. <u>Non-Monetary Effectiveness Analysis</u>

In planning new wastewater treatment facilities non-monetary effectiveness issues as well as monetary criteria need to be used in determining the preferred alternative.

This section includes a general evaluation of the three proposed biological treatment alternatives to determine which solution will maximize non-monetary effectiveness. The discussion will focus on the following categories:

- Environmental Impact
- Engineering Evaluation
- Implementability
- Energy Consumption
- Expandability
- Chemical Use
- Public Support
- Institutional & Legal Capability
- Regionalization
- Land Purchase & Easements

The non-monetary effectiveness ratings for the two biological treatment alternatives can be found in Exhibit 6-4. Following is a brief discussion of each of the above categories:

1. Environmental Impact

Each alternative was selected on the basis of its ability to achieve the planning area's wastewater treatment and water quality goals and objectives, and the ability to comply with requirements of the Kentucky Division of Water. The two primary periods when the environment could be damaged are during construction or during a major treatment process upset (assuming all alternatives considered will consistently meet permit discharge limits).

Both alternatives construction will take place immediately adjacent to the current plant site. This allows for continued operation of the existing plant until the new treatment plant is operational. This greatly reduces the environmental impact during construction. Alternative 1 rates higher due to its flexibility in treating higher flow rates.

For both options, construction procedures would include methods to safeguard the environment such as silt fences and proper material storage. The wastewater treatment plant is a reasonable distance from residential and commercial facilities and construction noise, dust, odor and traffic are not anticipated to be problems.

If a process upset occurs Alternative 1 does present the ability to turn solids over more quickly through the dewatering process. Alternative 1 also presents a higher level of process control and solids management options.

2. Engineering Evaluation

The primary goal of the selected alternative is to provide the most cost effective, environmentally sound and implementable wastewater treatment plant capable of achieving the Brandenburg Planning Area's water quality and service goals.

Both Alternatives are all fully capable of meeting the requirements of the Planning Area. They are proven treatment processes with multiple installations across the state and country.

The reliability of each of the alternatives is based on the long term operation of the various components of the mechanical systems which comprise the treatment process. The reliability of these systems is dependent on the quality of the manufacturer's equipment, the quality of initial installation and the implementation of satisfactory maintenance and preventive maintenance programs by the City of Brandenburg. Assuming that each of these considerations are addressed, each alternative will have the capability of long term reliability for the design life of the project.

3. Implementability

The ability to implement each alternative from both constructability and operational perspectives was considered in the evaluation of each of the respective alternatives.

From a constructability perspective, each treatment process requires some level of excavation on the adjacent site. Both Alternatives have installations throughout the state and present no unique construction challenges. Each alternative would require each of the existing lagoons to be taken out of service at a time during construction. The existing WWTP was designed with full redundancy.

From an operational perspective, Alternative 1 represents new equipment and processes, but provides greater flexibility.

Alternative 2 represents a similar treatment process to the existing WWTP that includes new aeration equipment and the addition of a polishing reactor, but lacks expandability.

4. Energy Consumption

Each alternative has distinctive energy requirements and a rating which is primarily based on cost and environmental impact. Alternative 1 has the higher energy consumption. Alternative 2 uses slightly less energy, but doesn't exhibit the same redundancy characteristics or process flexibility.

5. Expandability

Alternative 1 far outweighs Alternative 2 due to the fact that it can be expanded on the new plant site. No acquisition of additional land would be required to effectively double the plant capacity. To expand Alternative 2 would necessitate further land acquisition. It is important to note that once the new WWTP is commissioned and operational, Nucor Corp will acquire the existing plant site.

6. Chemical Use

Both alternatives will require chemical usage for disinfection. As previously discussed, Brandenburg WWTP has converted disinfection to PAA. Alternative 1 will require a polymer for the dewatering process. This does represent an increase in the annual Operations and Maintenance budget in the form of processing and disposal costs, but provides the ability to more effectively manage plant solids due to plant flow or loading changes.

7. Public Support

In order to address the public's interest the City conducted a public hearing on January 11, 2021 to inform the public of the needs of the treatment system as well as discuss the proposed treatment alternatives. At the meeting, projected construction and operations costs were discussed and their projected effect on sewer rates. The minutes and attendance roster of the public hearing are included in Appendix H.

The public acceptability of Alternatives 1 and 2 are similar because the City's wastewater infrastructure needs would be met by both options.

8. Institutional and Legal Capability

The City of Brandenburg has the institutional and legal capability to undertake any of the alternatives presented. All alternatives are considered equivalent for this category.

9. Regionalization

Only Alternative 1 represents the ability to provide regionalization of wastewater services if desired. The ability to effectively double the plant capacity on the new plant site allows for continued expansion in the Planning Area, and potentially the inclusion of services for nearby communities like Doe Valley, Kentucky.

10. Land Purchase and Easements

Both alternatives can be implemented on property currently owned by the City of Brandenburg. No purchase of new land and no easements should be required for any of the alternatives. Both alternatives are considered equivalent for this category.

11. Summary of Non-Monetary Effectiveness Analysis

Exhibit 6-4 provides non-monetary effectiveness ratings for both treatment alternative and compares the alternatives based on non-monetary effectiveness units (NEUs). Alternative 1 – (Orbal) Oxidation Ditch and Secondary Clarifiers (214,457) would be the preferred treatment alternative based on Non-Monetary Effectiveness Analysis. It also represent the City of Brandenburg's preference.

E. Collection System Alternatives

1. Purpose

The purpose of this section is to define and evaluate the available alternatives for expanding the existing wastewater collection system to accommodate the projected 2040 wastewater flows to be transported by the sewage collection system. As shown in the following sections, new gravity collector sewers are proposed to currently un-served areas to expand the collection system by the end of the planning period.

2. Definition of Alternatives

Three collection system upgrade alternatives were considered for accommodating Brandenburg's proposed collection system expansion. The collection system expansion alternatives that were considered include: 1) Conventional Gravity Collection System, 2) Vacuum Collection System, and 3) Low Pressure Collection System.

Alternative 1 – Conventional Gravity Collection System

Traditionally, wastewater collection systems consist of gravity sewers, pump stations and force mains. Although considered "low technology" when compared to alternative forms of waste collection, it is a tried-and-true method which a majority of municipalities employ. Brandenburg has had a conventional gravity system in place for roughly 60 years, since the early 1960s.

Alternative 2 – Vacuum Collection System

Vacuum sewage transport utilizes differential air pressure to create flow, as opposed to the gravity induced flow of conventional wastewater collection systems. A vacuum sewer system consists of three major components: the valve pit installation; vacuum collection and transmission conduits (service lines, branch lines, and mains), and the vacuum collection station. When a preset quantity of sewage flows into the valve pit a pneumatic signal is sent to the controller mounted on the interface valve, which is then opened by the vacuum. The valve stays open for a preset amount of time allowing the sewage to be drawn into the vacuum lines. Sewage is propelled through the lines at a velocity of 15-18 feet per second by energy created from the sewage/air mixture. The propulsive force's magnitude declines noticeably when the valve closes, but remains important as the admitted air continues to expand. Within seconds, friction slows the sewage and flow continues under the influence of gravity. Eventually, all motion ceases until the next valve cycles.

Sewage is drawn into the vacuum mains and into a collection tank by vacuum pumps. The collection tank and vacuum pumps are located in the vacuum collection/pumping station. As the tank fills, sensing rods activate the sewage pumps which, in turn, pump the sewage to a gravity interceptor sewer, wastewater pumping station, or wastewater treatment plant.

The vacuum collection system is most practical for small communities that lie on hilly terrain.

Alternative 3 – Low Pressure Collection System

The low pressure collection system is also most practical for small communities that lie on hilly terrain. Each house has an individual grinder pump that reduces waste to a finely ground slurry. The waste is then pumped through a common force main to a wastewater treatment facility. More often than not, there is no need for any lift or auxiliary pumping stations. In addition, infiltration and inflow problems are often eliminated, and the high efficiency pumps used require lower power operating costs than many typical major home appliances.

3. Collection System Alternative Selection

Although vacuum and low pressure wastewater collection systems can be sound alternatives to a conventional gravity sewer system, they were not considered to be viable alternatives for the

Brandenburg collection system. The reasons are that the City of Brandenburg has had a conventional gravity sewer system since the early 1960s, and to convert to an alternate form of technology would be both time consuming and expensive. In addition, maintenance on a new type of system would require additional training of a staff that is already experienced with the existing conventional gravity system. Therefore, the selected wastewater collection system alternative will consist of additions to the existing gravity sewer system.

4. Proposed Collection System Expansion

The potential expansion of the City of Brandenburg's Collection System has been broken out into the 3-10 year and 11-20 year planning phases. During the 0-2 year planning phase, the City will be completing construction of a new WWTP. The 3-10 year and 11-20 year planning phases are expanding into areas that are currently on Brandenburg's water system. The City may or may not choose to serve these potential customers, but since they are currently on the City's water system they would be the next logical locations for the City to expand.

A hydraulic model wasn't completed for the existing or proposed collection system for this Facilities Plan. If the City proceeds with designing and constructing the following planning phases, the completion of a hydraulic model is recommended. A hydraulic model would help establish capacity issues that exist with the system. In addition to CCTV identifying the areas that would potentially need to be replaced or rehabilitated, the model would be useful in establishing which sewers require upsizing.

A map of the proposed collection system improvements by planning phase can be found in Exhibit 6-5.

a. 3-10 Year Planning Phase

Table 6-3 below summarizes the proposed 3-10 year expansion to the existing Brandenburg Collection System. The planning phase consists of two existing neighborhoods, located south of the existing service area. See Exhibit 2-6 for the Planning Area Phasing. In order to serve the neighborhoods, a combination of gravity sewer and force main will be required. The Four Oaks Road neighborhood will serve 22 houses along Four Oaks Road, Miles Lane, and Bruno Circle. A 4" force main from the neighborhood will tie into the collection system at a manhole near Armory Place. The Quail Run and Knollwood Road neighborhood will serve 83 houses along Old State Road, Knollwood Road, Kelly Lane, Quail Run Road, Oakwood Drive, Rebecca Court, and Blaine Court. A 4" force main from the neighborhood will tie into the collection system at a manhole off Old State Road.

A preliminary total project cost estimate for the 3-10 year planning phase can be found in Exhibit 6-6.

<table>
<tr><th colspan="3">Table 6-3
3-10 Year Planning Phase
Proposed Collection System Expansion</th></tr>
<tr><td colspan="3">Four Oaks Road Neighborhood</td></tr>
<tr><td>Gravity Sewer</td><td>8"</td><td>2,440'</td></tr>
<tr><td rowspan="2">Force Main</td><td>2"</td><td>910'</td></tr>
<tr><td>4"</td><td>1,640'</td></tr>
<tr><td>Duplex Lift Stations</td><td colspan="2">2</td></tr>
<tr><td colspan="3">Quail Run and Knollwood Road Neighborhood</td></tr>
<tr><td>Gravity Sewer</td><td>8"</td><td>11,770'</td></tr>
<tr><td>Force Main</td><td>4"</td><td>2,810'</td></tr>
<tr><td>Duplex Lift Stations</td><td colspan="2">7</td></tr>
</table>

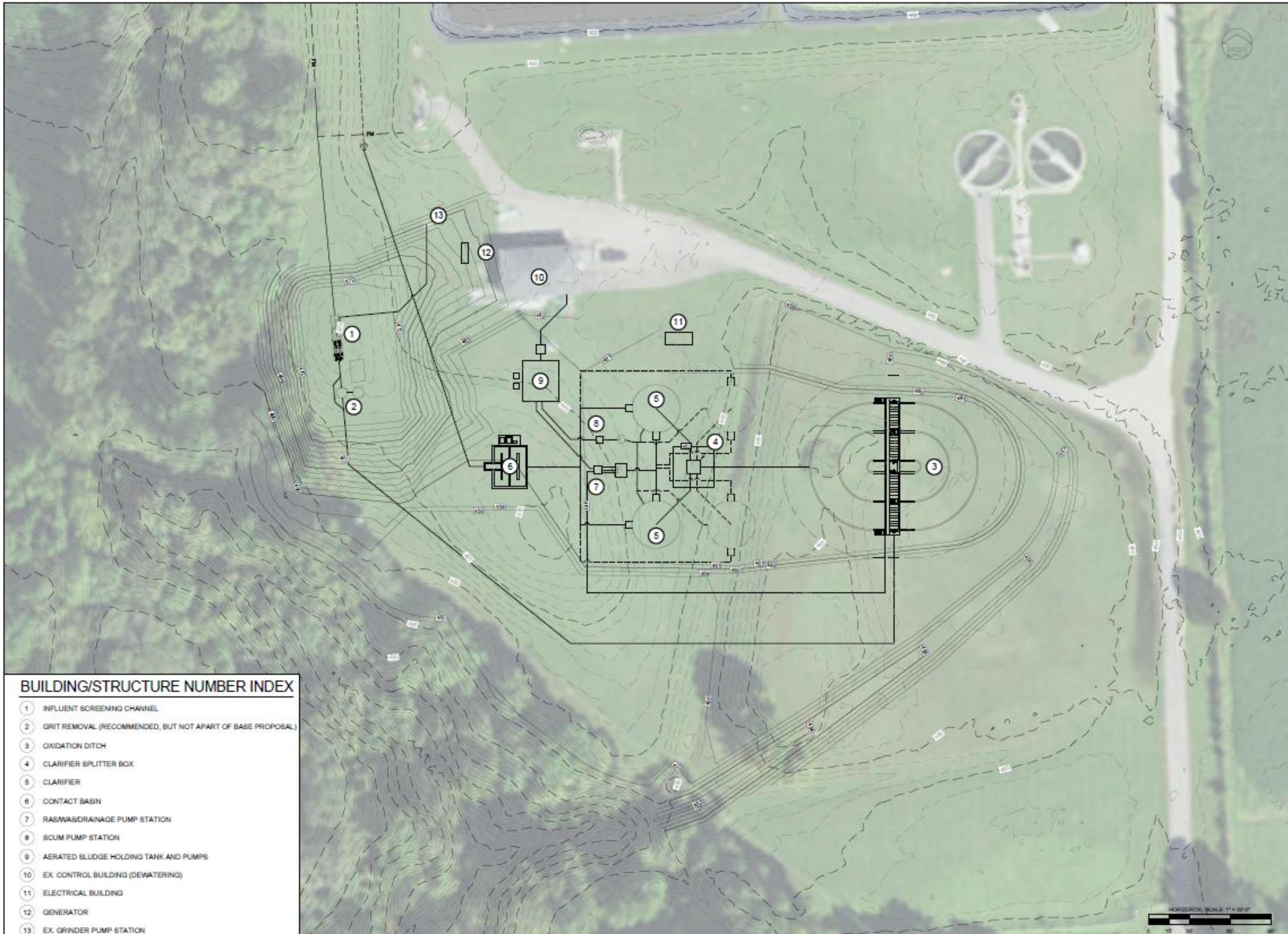
b. 11-20 Year Planning Phase

Table 6-4 below summarizes the proposed 11-20 year collection system expansion to the existing Brandenburg Collection. The planning phase consists of three existing neighborhoods and potential commercial and industrial growth. See Exhibit 2-6 for the Planning Area Phasing. The three existing neighborhoods will be served by a combination of gravity sewer and force main will be required. The potential industrial development is located near two existing pump stations, which can likely be directly tied into from the development.

The River Edge Road neighborhood will serve 21 houses along River Edge Road, River Edge Drive, and KY 228. An 8” gravity sewer from the neighborhood will tie into the collection system at the Brandenburg Bypass Pump Station.
The Windsor Place and Sun Valley Road neighborhood will serve 61 houses along Fairground Road, Sun Valley Road, and Windsor Place. An 8” gravity sewer from the neighborhood will tie into the collection system at the Fairgrounds Road Pump Station. The Christian Church and Bud Wilson Road neighborhood will serve 65 houses along Christian Church and Bud Wilson Road. A 4” force main from the neighborhood will tie into the collection system at a manhole on Ready Mix Road.

A preliminary total project cost estimate for the 11-20 year planning phase can be found in Exhibit 6-7.

Table 6-4 11-20 Year Planning Phase Proposed Collection System Expansion		
River Edge Road Neighborhood		
Gravity Sewer	8”	5,320’
Windsor Place and Sun Valley Road Neighborhood		
Gravity Sewer	8”	7,820’
Force Main	4”	2,000’
Duplex Lift Stations	1	
Christian Church and Bud Wilson Road Neighborhood		
Gravity Sewer	8”	8,780’
Force Main	2”	1,700’
	4”	4,150’
Duplex Lift Stations	7	



BUILDING/STRUCTURE NUMBER INDEX

1. INFLUENT SCREENING CHANNEL
2. GRIT REMOVAL (RECOMMENDED, BUT NOT APART OF BASE PROPOSAL)
3. OXIDATION DITCH
4. CLARIFIER SPLITTER BOX
5. CLARIFIER
6. CONTACT BASIN
7. RAS/WAS/DRAINAGE PUMP STATION
8. SCUM PUMP STATION
9. AERATED SLUDGE HOLDING TANK AND PUMPS
10. EX. CONTROL BUILDING (DEWATERING)
11. ELECTRICAL BUILDING
12. GENERATOR
13. EX. GRINDER PUMP STATION

GRW PROJECT NO. 4856-01
CLIENT PROJECT NO. XXXX

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PROCESS AND PIPING LAYOUT
OXIDATION DITCH OPTION
WASTEWATER TREATMENT PLANT P3
CITY OF BRANDENBURG, KENTUCKY

DESIGNED: JVP
DRAWN: NWG
REVIEWED: JVP
APPROVED: JVP

EXHIBIT
6-1.1

SCALE: 1" = 30'

OD-1

Exhibit 6-1.2
Brandenburg Wastewater Treatment Plant
Alternative 1
Oxidation Ditch w/ Secondary Clarification and Dewatering
Total Project Cost Estimate

Description		Quantity	Unit	Unit Cost	Cost
Screening					
Auger Monster Mechanical Bar Screen		1	EA	$10,000	$10,000
Manual Bar Screen		1	EA	$2,000	$2,000
Aluminum Grating		440	SF	$50	$22,000
10" Influent Mag meter and Vault		1	EA	$5,000	$5,000
Equipment Installation (20%)		1	LS	$7,800	$7,800
Soil Excavation		160	CY	$20	$3,200
Crushed Stone		50	CY	$25	$1,250
Reinforced Concrete Walls		51	CY	$750	$38,250
Reinforced Concrete Slab		50	CY	$550	$27,500
	Subtotal				**$117,000**
Grit Removal					
Grit Removal Equipment, Pump, Structure		1	LS	$150,000	$150,000
FRP Structure for Grit Classifier		1	EA	$50,000	$50,000
Spare Grit Pump		1	EA	$25,000	$25,000
Earthwork & Associated Piping		1	LS	$30,000	$30,000
	Subtotal				**$255,000**
Oxidation Ditch					
2-Channel Orbal System		1	LS	$213,000	$213,000
SmartBNR Lite Control System		1	LS	$36,000	$36,000
Variable Frequency Drives		1	LS	$21,000	$21,000
Equipment Installation (20%)		1	LS	$54,000	$54,000
Soil Excavation		4,670	CY	$20	$93,400
Crushed Stone		1,600	CY	$25	$40,000
Reinforced Concrete Walls		260	CY	$750	$195,000
Reinforced Concrete Slab		780	CY	$550	$429,000
	Subtotal				**$1,081,400**
Clarifier Splitter Box					
Slide Gate		2	EA	$20,000	$40,000
Equipment Installation (20%)		1	LS	$8,000	$8,000
Soil Excavation		50	CY	$20	$1,000
Crushed Stone		20	CY	$25	$500
Reinforced Concrete Walls		20	CY	$750	$15,000
Reinforced Concrete Slab		10	CY	$550	$5,500
	Subtotal				**$70,000**
Clarifiers					
Two - 35' Dia. Clarifiers		1	LS	$200,000	$200,000
Equipment Installation (20%)		1	LS	$40,000	$40,000
Soil Excavation		1,360	CY	$20	$27,200
Crushed Stone		1,500	CY	$25	$37,500
Reinforced Concrete Walls		60	CY	$750	$45,000
Reinforced Concrete Slab		180	CY	$550	$99,000
	Subtotal				**$448,700**

Exhibit 6-1.2
Alternative 1 - Continued

Contact Tank				
Slide Gate	2	EA	$20,000	$40,000
Aspirator (1 Duty / 1 Spare)	1	LS	$15,000	$15,000
Aluminum Handrail	100	LF	$60	$6,000
Aluminum Grating	10	SF	$50	$500
Effluent V-notch weir	1	LS	$5,000	$5,000
Equipment Installation (20%)	1	LS	$12,300	$12,300
Soil Excavation	190	CY	$20	$3,800
Crushed Stone	50	CY	$25	$1,250
Reinforced Concrete Walls	50	CY	$750	$37,500
Reinforced Concrete Slab	40	CY	$550	$22,000
Subtotal				**$143,350**
PAA Disinfection				
Combination Eyewash Shower	1	EA	$10,000	$10,000
Equipment Installation (20%)	1	LS	$2,000	$2,000
Remove and Install Existing Pump and PAA Unit/Controls	1	EA	$10,000	$10,000
Telfon FEP Tubing	30	LF	$10	$300
SCH 40 PVC Conduit	30	LF	$10	$300
Concrete Equipment Pad	5	CY	$550	$2,750
Subtotal				**$25,350**
Sludge Holding Tank				
Aeration System - Blowers/Coarse Bubble Diffusers	1	EA	$80,000	$80,000
Equipment Installation (20%)	1	LS	$16,000	$16,000
Soil Excavation	1,390	CY	$20	$27,800
Crushed Stone	230	CY	$25	$5,750
Reinforced Concrete Walls	150	CY	$750	$112,500
Reinforced Concrete Slab	170	CY	$550	$93,500
Subtotal				**$335,550**
RAS/WAS/Drain PS				
Submersible Pumps	3	EA	$25,000	$75,000
6-inch Check Valve	3	EA	$5,000	$15,000
6-inch Plug Valve	3	EA	$3,000	$9,000
6-inch PVC Force Main	400	LF	$35	$14,000
Equipment Installation (20%)	1	LS	$22,600	$22,600
Soil Excavation	210	CY	$20	$4,200
Crushed Stone	80	CY	$25	$2,000
Reinforced Concrete Walls	80	CY	$750	$60,000
Reinforced Concrete Slab	30	CY	$550	$16,500
Subtotal				**$218,300**
Scum PS				
Chopper Pump	1	LS	$30,000	$30,000
Equipment Installation (20%)	1	LS	$6,000	$6,000
Precast Wetwell / Valve vault	1	LS	$15,000	$15,000
Earthwork & Associated Piping	1	LS	$30,000	$30,000
Subtotal				**$81,000**
Sludge Dewatering				
Rotary Fan Press	1	LS	$250,000	$250,000
Equipment Installation (20%)	1	LS	$50,000	$50,000
Building Modifications	1	LS	$75,000	$75,000
Subtotal				**$375,000**

Exhibit 6-1.2 Alternative 1 - Continued				
Electrical Building				
Electrical Building with Equipment	200	SF	$1,300	$260,000
Site Prep	1	SF	$5,000	$5,000
Subtotal				**$265,000**
Demolish and Sludge Removal				
Sludge Removal and Thickening (5% Solids)	3,850	CY	$50	$192,500
Sludge Hauling and Disposal (15% Solids)	1,050	CY	$20	$21,000
Existing Liner Removal (Lagoons 1 & 2)	1	LS	$38,000	$38,000
Existing Liner Disposal (Lagoons 1 & 2)	240	CY	$20	$4,800
Temporary Containment Area	1	LS	$25,000	$25,000
Dewatering Lagoon to Remove Sludge	1	LS	$75,000	$75,000
Subtotal				**$356,300**
Sitework and Piping				
10-inch PVC Forcemain	360	LF	$75	$27,000
3-inch DI Yard Piping	800	LF	$16	$12,800
4-inch DI Yard Piping	20	LF	$22	$440
6-inch DI Yard Piping	475	LF	$26	$12,350
8-inch DI Yard Piping	250	LF	$36	$9,000
12-inch DI Yard Piping	550	LF	$55	$30,250
16-inch DI Yard Piping	280	LF	$75	$21,000
Yard Hydrant	5	EA	$200	$1,000
Gravel Drives and sidewalks	410	ton	$42	$17,179
Subtotal				**$131,019**
Main Pump Station Modifications				
Pumps and Controls	4	EA	$30,000	$120,000
Generator w/ Platform	1	EA	$120,000	$120,000
Miscellaneous PS improvement	1	LS	$110,000	$110,000
Subtotal				**$350,000**
Construction Cost Subtotal				**$4,252,969**
Mechanical, Electrical, & Instrumentation (21%)	1	LS	$893,000	**$893,000**
Subtotal				**$5,145,969**
Mobilization/Demobilization and General Conditions (6%)	1	LS	$309,000	**$309,000**
Bonding and Insurance (1.5%)	1	LS	$77,000	**$77,000**
Contractor Overhead and Profit (12%)	1	LS	$618,000	**$618,000**
Subtotal				**$6,149,969**
Construction Contingencies (20%)				**$1,230,031**
Total Construction Cost Estimate				***$7,380,000***
Non-construction Cost				$920,600
Total Project Cost Estimate				***$8,300,600***

Exhibit 6-1.3
Brandenburg Wastewater Treatment Plant
Alternative 1
Orbal Oxidation Ditch w/ Secondary Clarification and Dewatering
Annual Operation and Maintenance Cost

Item					Annual Cost
Labor Cost					
Salaries and Benefits	$120,000				
Total Annual Labor Cost					$120,000
General Cost					
Office Expenses	$5,000				
Utilities	$3,000				
Insurance	$36,000				
Telephone	$3,600				
Vehicle & Equipment Maintenance	$12,000				
Professional Fees	$2,400				
Lift Stations (excludes Main Influent PS)	$62,396				
Total Annual General Cost					$124,396
Existing Equipment Electrical Power Usage	hp/unit	no. units	hrs/day	kwH/day	
Influent Screen	2	1	24	36	
PAA Pumps	0.25	1	24	4	
Control Building Grinder Pump	0.33	1	2	0.5	
Total KW Hours/Day				*41*	
Annual Cost				*$1,042*	
New Equipment Electrical Power Usage	hp/unit	no. units	hrs/day	kwH/day	
Grit Pump	7.5	1	3	43	
Oxidation Ditch Rotors	20	3	24	1,074	
Clarifier Scraper/Skimmer	0.5	2	24	18	
RAS/WAS/Drain Pumps	10	2	24	358	
Scum Pumps	3	1	2	4	
Aerated Sludge Holding Tank PD Blowers	15	1	16	204	
Sludge Pumps to Rotary Press	3	1	5.5	13	
Rotary Press - Dewatering	15	1	5.5	64	
Total KW Hours/Day				*1,779*	
Annual Cost				*$45,441*	
Summary					
Daily Power Usage	1,819	kw-hr/day			
Annual Power Usage	664,038	kw-hr/yr			
Power Cost	$0.070	per kw-hr			
Plant Annual Power Cost				*$46,483*	
	hp/unit	no. units	hrs/day	kwH/day	
Main Influent PS	30	1	10.5	235	
Daily Power Usage	235	kw-hr/day			
Annual Power Usage	85,771	kw-hr/yr			
Power Cost	$0.070	per kw-hr			
Pump Station Annual Power Cost				*$6,004*	
Total Annual Power Cost				*$52,487*	$52,487

Exhibit 6-1.3
Alternative 1 - Continued

Existing Power Usage of Removed Equipment	hp/unit	no. units	hrs/day	kwH/day	
West Lagoon Surface Aerators	15	4	12	537	
East Lagoon Surface Aerators	15	4	5	224	
Clarifier Drive Units	0.5	2	24	18	
RAS Pumps	3.0	1	4	9	
Total KW Hours/Day				*788*	
Daily Power Usage	788		kw-hr/day	*-$20,128*	
Annual Power Usage	287,538		kw-hr/yr		
Power Cost	$0.070		per kw-hr		
Total Annual Power Cost					
Total Additional Annual Power Cost					**$31,317**
Dewatering Cost / Ton Dry Solids	Unit Cost	Unit	Solid Tons/Day		
Polymer Cost	$ 1.25	lb	0.65		
				$ 5,301	
Disposal Cost	$ 110	ton	5.0		
				$ 143,597	
Total Estimated Dewatering Cost					**$148,898**
Disinfection Cost - Peracetic Acid					
Annual Peracetic Acid Cost	$18,265				
Annual Hose Replacement Cost	$2,400				
Total Annual Disinfection Cost					**$20,665**
Total Annual Operating and Maintenance Cost					**$497,763**

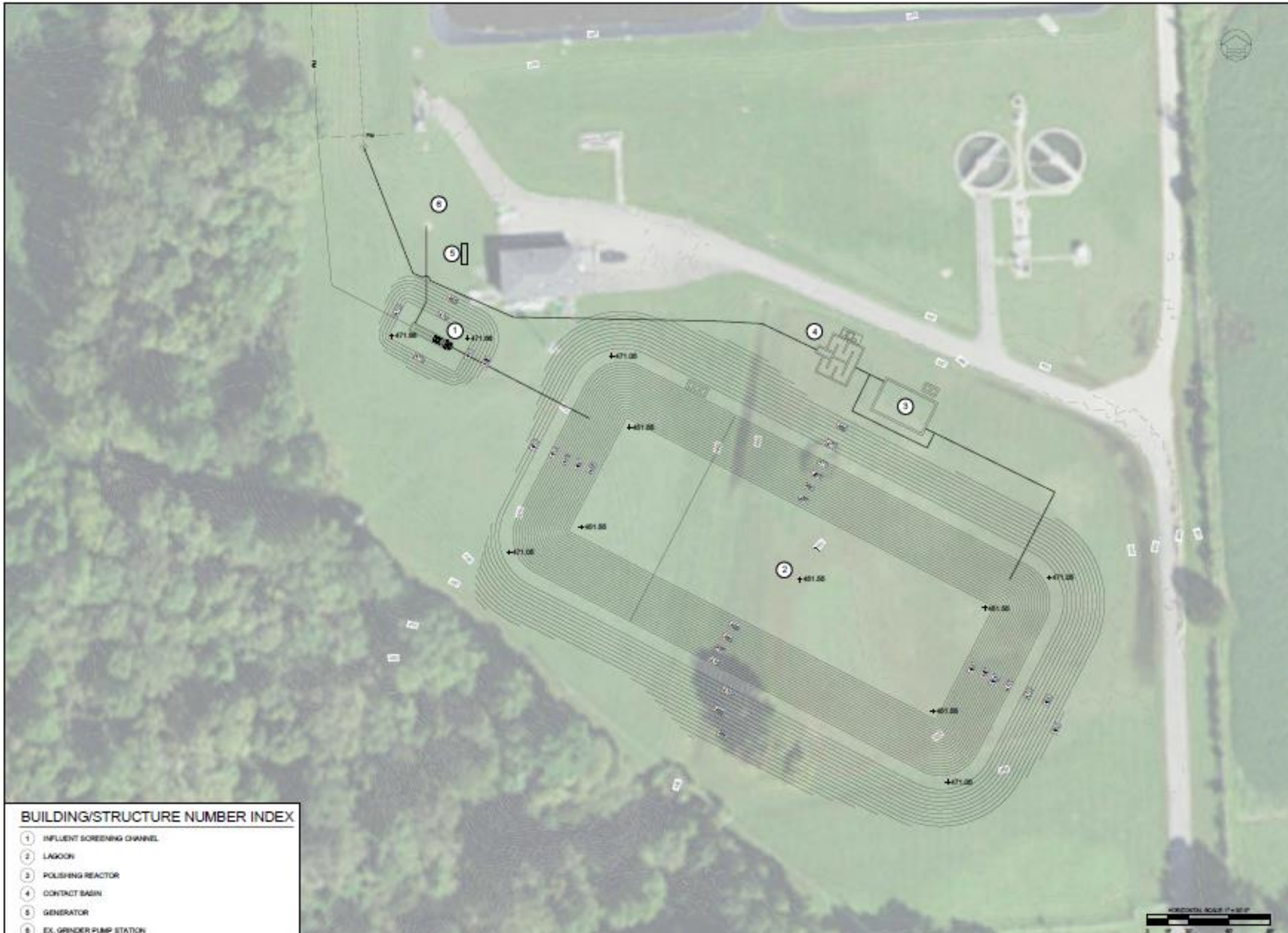
Exhibit 6-1.4
Brandenburg Wastewater Treatment Plant
Alternative 1
Orbal Oxidation Ditch
20-Year Salvage Value

Description	Cost	Salvage Value
Existing Screening	$117,000	$26,300
Grit Removal	$255,000	$50,000
Oxidation Ditch	$1,081,400	$249,600
Clarifier Splitter Box	$70,000	$8,200
Clarifiers	$448,700	$57,600
Contact/Aeration Tank	$143,350	$23,800
PAA Disinfection	$25,350	$1,100
RAS/WAS/Drain PS	$218,300	$37,600
Scum PS	$81,000	$13,500
Solids Dewatering	$375,000	$30,000
Electrical Building	$265,000	$26,000
Main Pump Station Modifications	$350,000	$48,000
Sitework and Yard Piping	$131,019	$56,420
Total Salvage Value		**$497,700**

Note: Equipment is assumed to have a salvage value of 0% after 20 years, structures are assumed to have a salvage value of 40% after 20 years, and pipe is assumed to have a salvage value of 50% after 20 years.

Exhibit 6-1.5
Brandenburg Wastewater Treatment Plant
Alternative 1
Orbal Oxidation Ditch
Present Worth Analysis

Total Project Cost			**$8,300,600**
Present Worth of Annual Operating Cost Calculation			
Annual Operating Cost	$497,763	per year	
Discount Rate	2.750%		
Life of Project	20	years	
Present Worth of Annual Operating Cost			**$7,579,564**
Present Worth of Salvage Value			
Salvage Value	$497,700		
Discount Rate	2.750%		
Life of Project	20	years	
Present Worth of Salvage Value			**$289,288**
Approximate Total Present Worth			**$15,591,000**



BUILDING/STRUCTURE NUMBER INDEX

1. INFLUENT SCREENING CHANNEL
2. LAGOON
3. POLISHING REACTOR
4. CONTACT BASIN
5. GENERATOR
6. EX. GRINDER PUMP STATION

PROCESS AND PIPING LAYOUT
LAGOON OPTION

WASTEWATER TREATMENT PLANT P3
CITY OF BRANDENBURG, KENTUCKY

engineering | architecture | geospatial

EXHIBIT
6-2.1

1" = 30'

LG-1

Exhibit 6-2.2
Brandenburg Wastewater Treatment Plant
Alternative 2
Lemna Biological Lagoon and Polishing Reactor
Total Project Cost Estimate

Description	Quantity	Unit	Unit Cost	Cost
Screening				
Auger Monster Mechanical Bar Screen	1	EA	$10,000	$10,000
Manual Bar Screen	1	EA	$2,000	$2,000
Aluminum Grating	440	SF	$50	$22,000
10" Influent Mag meter and Vault	1	EA	$5,000	$5,000
Equipment Installation (20%)	1	LS	$7,800	$7,800
Soil Excavation	160	CY	$20	$3,200
Crushed Stone	50	CY	$25	$1,250
Reinforced Concrete Walls	51	CY	$750	$38,250
Reinforced Concrete Slab	50	CY	$550	$27,500
Subtotal				**$117,000**
Lagoon				
Baffle	1	EA	$60,000	$60,000
Aeration	1	LS	$100,000	$100,000
Blowers and Control Panel	1	LS	$300,000	$300,000
Equipment Installation (20%)	1	LS	$92,000	$92,000
Geocomposite and Installation	10,552	SQ YD	$10	$105,517
Geomembrane and Installation	10,552	SQ YD	$10	$105,517
Soil Excavation	21,750	CY	$20	$435,000
6-inch DI Air Piping	200	LF	$60	$12,000
4-inch DI Air Piping	20	LF	$50	$1,000
6-inch DI Butterfly Valve w/ Electric Actuator	1	EA	$3,000	$3,000
Concrete Equipment Pad	8	CY	$550	$4,400
DO Probe and Installation	1	EA	$4,000	$4,000
Subtotal				**$1,222,433**
Polishing Reactor				
Lemna Polishing Reactor	1	LS	$200,000	$200,000
Blowers and Control Panel	1	EA	$75,000	$75,000
Aluminum Handrail	200	LF	$60	$12,000
Equipment Installation (20%)	1	LS	$57,400	$57,400
4-inch DI Air Piping	50	LF	$50	$2,500
2-inch DI Air Piping	25	LF	$40	$1,000
Soil Excavation	930	CY	$20	$18,600
Crushed Stone	140	CY	$25	$3,500
Reinforced Concrete Walls	245	CY	$750	$183,750
Reinforced Concrete Slab	130	CY	$550	$71,500
Concrete Equipment Pad	8	CY	$550	$4,400
Subtotal				**$629,650**
Contact Tank				
Slide Gate	2	EA	$20,000	$40,000
Aspirator (1 Duty / 1 Spare)	1	LS	$15,000	$15,000
Aluminum Handrail	100	LF	$60	$6,000
Aluminum Grating	10	SF	$50	$500
Effluent V-notch weir	1	LS	$5,000	$5,000
Equipment Installation (20%)	1	LS	$12,300	$12,300
Soil Excavation	190	CY	$20	$3,800
Crushed Stone	50	CY	$25	$1,250
Reinforced Concrete Walls	50	CY	$750	$37,500
Reinforced Concrete Slab	40	CY	$550	$22,000
Subtotal				**$143,350**

Exhibit 6-2.2 Alternative 2 -Continued				
PAA Disinfection				
Combination Eyewash Shower	1	EA	$10,000	$10,000
Equipment Installation (20%)	1	LS	$2,000	$2,000
Remove and Install Existing Pump and PAA Unit/Controls	1	EA	$10,000	$10,000
Telfon FEP Tubing	30	LF	$10	$300
SCH 40 PVC Conduit	30	LF	$10	$300
Concrete Equipment Pad	5	CY	$550	$2,750
Subtotal				**$25,350**
Demolish and Sludge Removal				
Sludge Removal and Thickening (5% Solids)	3,850	CY	$50	$192,500
Sludge Hauling and Disposal (15% Solids)	1,050	CY	$20	$21,000
Existing Liner Removal (Lagoons 1 & 2)	1	LS	$38,000	$38,000
Existing Liner Disposal (Lagoons 1 & 2)	240	CY	$20	$4,800
Temporary Containment Area	1	LS	$25,000	$25,000
Dewatering Lagoon to Remove Sludge	1	LS	$75,000	$75,000
Subtotal				**$356,300**
Sitework and Piping				
10-inch PVC Forcemain	205	LF	$75	$15,375
3-inch DI Yard Piping	90	LF	$16	$1,440
12-inch DI Yard Piping	350	LF	$55	$19,250
16-inch DI Yard Piping	425	LF	$75	$31,875
Yard Hydrant	5	EA	$200	$1,000
Gravel Drives and sidewalks	100	Ton	$42	$4,190
Subtotal				**$57,755**
Main Pump Station Modifications				
Pumps and Controls	4	EA	$30,000	$120,000
Generator w/ Platform	1	EA	$120,000	$120,000
Miscellaneous PS improvement	1	LS	$110,000	$110,000
Subtotal				**$350,000**
Construction Cost Subtotal				**$2,901,838**
Mechanical, Electrical, & Instrumentation (21%)	1	LS	$609,000	**$609,000**
Subtotal				**$3,510,838**
Mobilization/Demobilization and General Conditions (6%)	1	LS	$211,000	**$211,000**
Bonding and Insurance (1.5%)	1	LS	$53,000	**$53,000**
Contractor Overhead and Profit (12%)	1	LS	$421,000	**$421,000**
Subtotal				**$4,195,838**
Construction Contingencies (20%)				**$839,161**
Total Construction Cost Estimate				***$5,035,000***
Non-construction Cost				$920,600
Total Project Cost Estimate				***$5,955,600***

Exhibit 6-2.3
Brandenburg Wastewater Treatment Plant
Alternative 2
Lemna Lagoon
Annual Operation and Maintenance Cost

Item					Annual Cost
Labor Cost					
Salaries and Benefits	$120,000				
Total Annual Labor Cost					**$120,000**
General Cost					
Office Expenses	$5,000				
Utilities	$3,000				
Insurance	$36,000				
Telephone	$3,600				
Vehicle & Equipment Maintenance	$12,000				
Professional Fees	$2,400				
Lift Stations (excludes Main Influent PS)	$62,396				
Total Annual General Cost					**$124,396**
Existing Equipment Electrical Power Usage	hp/unit	no. units	hrs/day	kwH/day	
Influent Screen	2	1	24	36	
PAA Pumps (existing)	0.25	1	24	4	
Control Building Grinder Pump (existing)	0.33	1	2	0.5	
Total KW Hours/Day				*41*	
Annual Cost				*$ 1,042*	
New Equipment Electrical Power Usage	hp/unit	no. units	hrs/day	kwH/day	
Blowers - Lagoon	40	2	24	1,432	
Blowers - Polishing Reactor	7.5	1	24	134	
Total KW Hours/Day				*1,567*	
Annual Cost				*$ 40,027*	
Summary					
Daily Power Usage	1,607		kw-hr/day		
Annual Power Usage	586,692		kw-hr/yr		
Power Cost	$0.070		per kw-hr		
Plant Annual Power Cost				*$41,068*	
	hp/unit	no. units	hrs/day	kwH/day	
Main Influent PS	30	1	10.5	235	
Daily Power Usage	235		kw-hr/day		
Annual Power Usage	85,771		kw-hr/yr		
Power Cost	$0.070		per kw-hr		
Pump Station Annual Power Cost				*$6,004*	
Total Annual Power Cost				*$47,072*	**$47,072**

Exhibit 6-2.3
Alternative 2 - Continued

Existing Power Usage of Removed Equipment	hp/unit	no. units	hrs/day	kwH/day	
West Lagoon Surface Aerators	15	4	12	537	
East Lagoon Surface Aerators	15	4	5	224	
Chlorination/Dechlorination Induction Pumps	0.5	2	24	18	
Clarifier Drive Units	0.5	2	24	18	
RAS Pumps	3.0	1	4	9	
Total KW Hours/Day				*806*	
Daily Power Usage	806		kw-hr/day	*-$20,585*	
Annual Power Usage	294,073		kw-hr/yr		
Power Cost	$0.070		per kw-hr		
Total Annual Power Cost					
Total Additional Annual Power Cost					**$25,446**
Disinfection Cost - Peracetic Acid					
Annual Peracetic Acid Cost	$18,265				
Annual Hose Replacement Cost	$2,400				
Total Annual Disinfection Cost					**$20,665**
Total Annual Operating and Maintenance Cost					**$337,579**

Exhibit 6-2.4
Brandenburg Wastewater Treatment Plant
Alternative 2
Lemna Lagoon and Polishing Reactor
20-Year Salvage Value

Description	Cost	Salvage Value
Existing Screening	$117,000	$26,300
Lagoon	$1,222,433	$8,260
Contact/Aeration Tank	$143,350	$23,800
Polishing Reactor	$629,650	$105,610
PAA Disinfection	$25,350	$1,100
Main Pump Station Modifications	$350,000	$48,000
Sitework and Yard Piping	$57,755	$33,970
Total Salvage Value		**$165,070**

Note: Equipment is assumed to have a salvage value of 0% after 20 years, structures are assumed to have a salvage value of 40% after 20 years, and pipe is assumed to have a salvage value of 50% after 20 years.

Exhibit 6-2.5
Brandenburg Wastewater Treatment Plant
Alternative 1
Lemna Lagoon and Polishing Reactor
Present Worth Analysis

Total Project Cost			**$5,955,600**
Present Worth of Annual Operating Cost Calculation			
Annual Operating Cost	$337,579	per year	
Discount Rate	2.750%		
Life of Project	20	years	
Present Worth of Annual Operating Cost			**$5,140,400**
Present Worth of Salvage Value			
Salvage Value	$165,070		
Discount Rate	2.750%		
Life of Project	20	years	
Present Worth of Salvage Value			**$95,947**
Approximate Total Present Worth			**$11,001,000**

Exhibit 6-3
Brandenburg Wastewater Treatment Plant
Present Worth Analysis Summary

Biological Treatment Alternatives					
Alternative	**Description**	**Project Cost**	**Annual O&M**	**Salvage Value**	**Total Present Worth**
1	Oxidation Ditch and 2ndry Clarifiers	$8,300,600	$663,073	$497,700	$18,109,000
2	Dual Cell Lagoon and Polishing Reactor	$5,955,600	$502,889	$165,070	$13,518,000

The biological treatment alternatives include total project cost the City of Brandenburg's new WWTP which includes common demolition and closure requirements, new equipment, and existing equipment upgrades or refurbishments.

Exhibit 6-4
Brandenburg Wastewater Treatment Plant
Non-monetary Effectiveness Analysis

		Alternative 1		Alternative 2		Alternative 3	
		Orbal Oxidation Ditch		Lemna Lagoon		By Others N/A	
Parameter	**Weight**	**Rating**	**Score**	**Rating**	**Score**	**Rating**	**Score**
Environmental Impact	1.00	10	10.00	8	8.00	N/A	N/A
Engineering Evaluation	1.00	8	8.00	4	4.00	N/A	N/A
Implementability	0.90	10	9.00	8	7.20	N/A	N/A
Energy Consumption	0.80	8	6.40	8	6.40	N/A	N/A
Expandability	0.70	9	6.30	1	0.70	N/A	N/A
Chemical Use	0.70	8	5.60	8	5.60	N/A	N/A
Public Support	0.80	8	6.40	4	3.20	N/A	N/A
Institutional & Legal Capability	0.90	10	9.00	10	9.00	N/A	N/A
Regionalization	0.70	10	7.00	1	0.70	N/A	N/A
Land Purchase & Easements	0.50	10	5.00	10	5.00	N/A	N/A
Total Score			**72.70**		**49.80**		**N/A**
Total Present Worth			**$15,591,000**		**$11,001,000**		**N/A**
Non-Monetary Effectiveness Units (NEU)			**214,457**		**220,904**		**N/A**

Note: 1. The **Weight** of each parameter is a measure of the relative concerns of that parameter compared to other parameters, on a scale of 0.0 to 1.0, with the highest weighted parameters being those which are considered the most critical.

2. The **Rating** for each alternative is a measure of the relative implementation concern of that alternative on the parameter compared to other alternatives, on a scale of 0.0 to 10.0, with the highest ratings given to the alternative that best satisfies the parameter.

3. The Non-monetary Effectiveness Unit (NEU) is a measure of the relative implementation concern due to construction and operation of each alternative. The alternative with the **lowest NEU is the most capable of implementation**.

4. Non-monetary Effectiveness Units (NEU) = Total Present Worth/Total Score

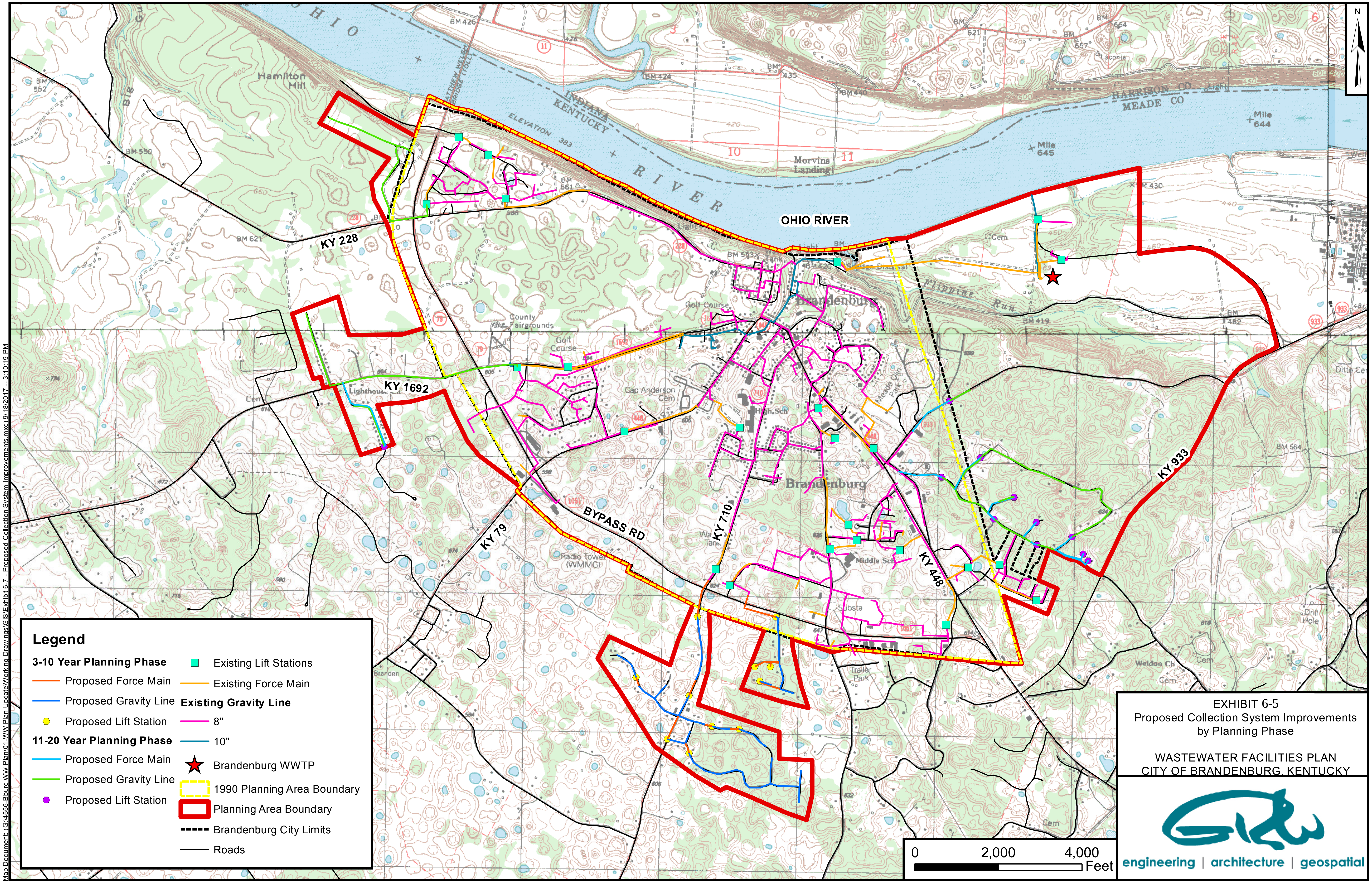


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Exhibit 6-6
Proposed Wastewater Collection System Improvements
Preliminary Total Project Cost Estimate
3-10 Year Planning Phase

Item	Estimated Cost*
Construction	$2,435,204
Engineering Design	$145,065
Site Surveys	$40,000
Geotechnical Engineering	$60,000
Bidding	$19,000
Construction Administration	$38,000
Resident Inspection	$110,000
Land and Right-of-Way	$20,000
Legal	$10,000
Start Up Services	$30,000
Contingency (15%)	$366,000
Preliminary Total Project Cost Estimate	$3,273,269

* Estimated costs based on 2020 pricing

Exhibit 6-7
Proposed Wastewater Collection System Improvements
Preliminary Total Project Cost Estimate
11-20 Year Planning Phase

Item	**Estimated Cost***
Construction	$3,050,563
Engineering Design	$175,656
Site Surveys	$60,000
Geotechnical Engineering	$60,000
Bidding	$23,000
Construction Administration	$46,000
Resident Inspection	$127,000
Land and Right-of-Way	$30,000
Legal	$15,000
Start Up Services	$30,000
Contingency (15%)	$458,000
Preliminary Total Project Cost Estimate	$4,075,219

* Estimated costs based on 2020 pricing

Chapter 7
Selected Plan

A. <u>*Selected Treatment Alternative*</u>

Alternative 1 – Oxidation Ditch and Secondary <u>Treatment Plant</u>: The selected treatment alternative is Alternative 1 – Oxidation Ditch and Secondary Clarification. The alternative meets all project goals and objectives and attains the best Non-monetary Effectiveness rating. The new plant will be rated 0.500 MGD average daily flow and 1.50 MGD peak hydraulic flow, an increase from the current plant's ratings of 0.312. MGD and 0.932 MGD respectively. Elements of the recommended plant upgrades are described below. The existing facultative lagoons will be dredged and abandoned, mechanical equipment removed, and a plant closure plan completed.

Liquid Process Stream

The existing pumps in the influent pump station are not capable of pumping the projected peak 1.5 MGD to the new plant site with the largest pump out of service. The plan is to replace the existing pumps with Four (4) new submersible pumps that have a 1.5 MGD capacity with the largest pump out of service. Flow measurement will be accomplished with a 10" magnetic flow meter installed in the line to the plant influent.

New parallel channels will be constructed and new screening/compacting equipment will be installed. The parallel, bypass channel, will be equipped with a manual bar screen, allowing for removal of the primary channel from service for maintenance. Each channel will be capable of handling the 1.5 MGD peak hourly flow. The existing WWTP influent sampler will be relocated to downstream from the screening facility and will collect a 24 hour composite sample representative of the daily influent flow.

A single grit removal system will be constructed consisting of two concrete structures; one each for a grit concentrator and one for a grit pump system. The system is designed to remove 95% of all grit greater than 106 microns at ADF conditions. Grit is collected in a sump under the concentrator, and fluidized with plant potable water. The fluidized grit is pumped to a grit dewatering box (decanter) in a newly constructed building adjacent to the system for disposal. The grit removal structure will be constructed to incorporate the ability to expand the WWTP through the addition of a second grit concentrator.

The selected plan includes a two ring, series oriented oxidation ditch. The process incorporates a concentric loop design with dedicated zones for specific treatment processes as needed. Typical flow patterns introduce screened and degritted influent and Return Activated Sludge (RAS) into the outer ring. Manually actuated valves are included to allow the introduction of influent or RAS to the inner ring as desired to provide operational flexibility.

Each of the two rings includes two (2) disc assemblies, each with 22 total discs per ring. A center "island" with an adjustable fixed weir will house a center drain well with an effluent pipe to the secondary clarifiers. A passive recycle using a diversion gate will divert a small portion of flow from the inner ring back to the outer ring to allow for enhanced nitrogen removal. The design of the ditch includes the ability to operate in "storm-flow" mode allowing high flows through the ditch without washing biological solids from the system. Each ring includes a manually operated drain valve in a sump for dewatering. The plant site has been designed to allow expansion without the need for additional land.

The ditch can be expanded with a third ring in the future, effectively doubling the capacity, as well as allowing for biological nutrient removal (BNR) of Phosphorus and Nitrogen if future limits are implemented.

Flow from the oxidation ditch is directed to a secondary clarifier influent splitter box. Constructed to direct flow to two (2) secondary clarifiers, the splitter box will be designed with the capability to serve four (4) clarifiers for future expansion at Brandenburg WWTP. Flow will enter the bottom of the splitter and overflow a weir wall with two (2) manually actuated weir gates to allow flow balancing between the clarifiers or remove a clarifier from service for maintenance.

The system includes two (2) center feed, perimeter withdrawal circular clarifiers, with a submerged effluent launder (SEL), hydraulic level management system, bottom sludge collector/sweep and top skimmer with scum trough. The clarifier drive will be constant speed. Solids removal will be controlled by telescoping valves. The clarifiers will share a common return activated sludge (RAS)/waste activated sludge (WAS)/drain pump station. Each clarifier will include a manually operated drain valve/drain sump for dewatering through the RAS/WAS/drain pump station to the oxidation ditch influent. The WWTP will retain “Ten States Standards” with one clarifier out of service at ADF conditions and PHF conditions with two clarifiers in service.

As designed for the oxidation ditch, the plant site allows for up to two additional clarifiers of the same size. This expansion can also take place without the need for additional land.

Effluent from the clarifiers is combined into a common line as influent to the disinfection contact chamber. The existing Peracetic Acid (PAA) delivery system, permitted in 2019, will be used for disinfection. A new contact chamber will incorporate a dual-sided maze structure with manually actuated influent gates to independent sides. The dual-sided construction will allow for the removal of one side of the chamber for maintenance. For an estimated 30 minutes of PAA contact time, normal operations at ADF conditions require only one side to be in operation. Adjustable fixed weirs at the effluent end of each channel of the contact basin will provide additional capability to adjust contact time. The effluent from the contact chamber will leave through a common Aeration Chamber. Effluent aeration will be accomplished in a two cell basin at the end of, and as part of, the disinfection chamber. Aeration will be achieved through the fall over the weir exiting the disinfection contact chamber. The basin will include an underflow baffle between cells to calm flow prior to a V- notch weir for effluent flow measurement. An effluent sample well will also be included. A small hydraulic break after the V- notch weir will occur in a box just upstream of the plant effluent line.

An existing sampler will be relocated to the discharge sample well. The sampler will collect a 24 hour composite sample representative of the daily effluent flow. Effluent will gravity flow through a new line and connect to the existing line with a discharge point in the Ohio River.

Solids Process Stream

Solids collected by the secondary clarifiers are removed from the bottom as they are pushed to a collection sump well by the bottom sludge collectors/sweeps of the clarifier. The solids removal rate will be controlled by telescoping valves in solids wells integral to the perimeter of the clarifiers and piped to a RAS/WAS/Drain pump station. The station will contain three (3) identical VFD pumps with each pump capable of supplying at least 150% of the ADF to the Oxidation Ditch as Return Activated Sludge (RAS). Additionally, the pump size will allow for reduced wasting time per day and meet the solids removal demands. The three (3) pumps will discharge to a common header in a connected valve vault. Each pump discharge in the vault will include a manually operated plug valve, check valve, and pressure gauge. An RAS magnetic flow meter in the vault will be installed on the common RAS header. Downstream of the common header and upstream of the RAS magnetic flow meter, a force main for the Waste Activated Sludge (WAS) pumps will “tee” off to feed an aerated sludge holding tank with WAS.

This station will also serve as a drainage pump station for the oxidation ditch, clarifiers, disinfection basin and other plant structures.

Scum collected from the two (2) clarifiers will discharge to a scum pump station. The station will include a chopper pump which will discharge through a dedicated scum line to the aerated solids holding tank through a manually activated valve.

The aerated solids holding tank provides temporary storage of wasted solids prior to dewatering operations. The basin will provide 4.1 days of storage based on its working volume. At the calculated solids waste rate the tank will allow for five (5) day per week, eight (8) hour per day dewatering while retaining volume to waste normally on the additional two days and stay within the working volume of the tank. A telescoping valve for decanting will be provided for return of supernatant to the oxidation ditch influent through the same gravity drain line for solids return to the RAS/WAS/Drain pump station. Two (2) positive displacement blowers in fully contained weatherproof packages with sound attenuation will supply a coarse bubble aeration system on the tank floor through a discharge header with valves to isolate individual blowers for maintenance.

After decanting, settled solids from the aerated solids holding tank will be pumped to the dewatering unit through a variable frequency driven, progressive cavity feed pump. A spare pump will be onsite – but not installed. The pump will supply settled solids through a line with a magnetic flow meter with totalizer capability to the system flocculation system. The meter will be supplied by the dewatering equipment supplier. The feed line to dewatering will also contain pressure indication. The integral control system for the dewatering system will provide start, stop, and speed signals for the feed pump.

Dewatering of solids will be accomplished with fan press dewatering equipment. The press will provide operations the ability to dewater five (5) days per week, eight (8) hours per day. The rotary fan press is anticipated to produce a 15% - 18% dry solids dewatered cake product for disposal. A control system integral to the dewatering system will provide for unattended operation as provided with the instrumentation on the turn-key system. Filtrate and press wash water will be pumped to either the influent screen channel or the RAS/WAS/Drain pump station. The dewatering system and cake conveyance system modifications will be installed in the existing Control Building which will be modified to house and facilitate removal of a roll-off for dewatered cake. A truck loading option will be available for loading "liquid" settled solids from the holding tank into a tanker truck in the event of a dewatering equipment outage.

Ancillary Site Improvements

A new skid mounted factory assembled electrical building will be located near the existing control building. New gravel drives and walkways will be added, as well as an emergency generator.

Exhibit 7-1 presents the flow diagram for the selected treatment alternative and Exhibit 7-2 presents the site layout for the selected treatment alternative.

B. Wastewater Treatment Plant Effluent Discharge Limits and Reliability Requirements

The Kentucky Division of Water (KDOW) performed a waste load allocation analysis for Brandenburg's WWTP.

The proposed KPDES permit effluent limits and reliability requirements based on the waste load allocation analysis are presented in Appendix D. A summary of the proposed KPDES permit effluent limits and reliability requirements are presented in Table 7-1.

The selected treatment alternative will be designed to comply with the proposed KPDES effluent limits and reliability requirements. The plant does not currently have nutrient limits, but is required to monitor plant effluent for Total Phosphorus and Total Nitrogen (mg/l). Brandenburg's WWTP is not expected to have either nutrient limit due to the outfall being located on the Ohio River.

If the WWTP receives nutrient limits, modifications to the new treatment processes, or additional treatment processes, may be required to meet the limit requirements. The new plant is designed to have the ability to alter or add processes accordingly.

Table 7-1 Proposed Monthly Average KPDES Permit Limits and Reliability Requirements	
Effluent Parameter	**Value**
BOD_5	30 mg/l
TSS	30 mg/l
Ammonia-Nitrogen	20 mg/l
Dissolved Oxygen (min.)	2 mg/l
Total Residual Chlorine	N/A (see Note below) .011 (if used)
Total Nitrogen	Monitor
Total Phosphorus	Monitor
E. Coli	130 mg/l
Reliability Classification	Grade A

NOTE: In May 2017, Brandenburg WWTP replaced the existing chlorination and de-chlorination disinfection system with a Peracetic Acid (PAA) disinfection system. The permit modification became effective December 1, 2019. The permit expiration date of January 31, 2021 did not change. The modified permit is presented in Appendix D.

C. *Influent Design Parameters*

The selected alternative will be designed based on the influent parameters listed in Table 7-2.

The background for the influent design parameters were previously discussed in Chapter 4.

Table 7-2 2040 Brandenburg WWTP Influent Design Parameters	
Influent Parameter	**Value**
Average Daily Flow	0.500 MGD
Peak Hydraulic Flow	1.5 MGD
BOD_5	1,685 lbs/day
BOD_5	404 mg/l
TSS	1,601 lbs/day
TSS	384 mg/l
Ammonia-Nitrogen	154.3 lbs/day*
Ammonia-Nitrogen	37 mg/l*

*Based on the most recent performance data and projected flows. The City began sampling influent ammonia-nitrogen in May 2018.

D. *Cost Effectiveness Analysis*

Table 7-3 below presents a summary of the present worth cost estimate for the selected treatment alternative. The selected treatment alternative had a higher total project cost and the higher present worth cost ($15,591,000) of the two alternatives considered.

Table 7-3 Project Cost Estimate Summary for Selected Treatment Alternative – Oxidation Ditch and Secondary Clarifiers	
Item	**Estimated Cost**
Total Project Cost	$8,300,600
Annual Operation and Maintenance	$497,763
Salvage Value	$497,700
Total Present Worth	$15,591,000

E. Non-monetary Effectiveness Analysis and Environmental Impact of Selected Alternative

The selected treatment had the lower Non-monetary Effectiveness Unit score (214,457) of the treatment alternatives considered and meets the goals and objectives of the planning area without impacting environmentally sensitive areas. The low score equates to the alternative that is most capable of implementation. The selected treatment alternative will improve the overall environmental quality of the area by providing an effective treatment system that is able to treat current and projected flows while complying with KPDES permit limits.

The selected alternative will be constructed adjacent to the existing plant site and will not impact any new surrounding areas or receiving streams. The existing location is comfortably removed from residential areas and does not detrimentally affect the public. It also allows for continued operation of the existing WWTP without any interruption of service or adverse environmental impact.

F. Operation & Maintenance Requirements

The annual operation and maintenance cost for the selected alternative is estimated to be $497,763 (see Exhibit 6-3.3. The increase in O&M is due to several new pieces of electrical equipment at the plant associated with the new processes, including disc systems for the oxidation ditch, clarifier motors, new pumping requirements, solids handling equipment and an aeration system for the solids holding tank. The O&M total is further impacted by the costs associated with the solids conditioning and disposal. There is an offset realized from the removal of some less efficient electrical equipment. The new plant will have sufficient equipment to meet the Reliability Class A requirements, and provide for continued operation during required preventive maintenance procedures.

G. Collection System Improvements

The potential expansion of the City of Brandenburg's Collection System has been broken out into the 3-10 year and 11-20 year planning phases. During the 0-2 year planning phase, the City will be constructing and commissioning the new WWTP. The 3-10 year and 11-20 year planning phases are expanding into areas that are currently on Brandenburg's water system. The City may or may not choose to serve these potential customers, but since they are currently on the City's water system they would be the next locations for the City to expand. The inclusion of Nucor in the Brandenburg-Meade County area will not impact the collection system planning as Nucor will not be sending wastewater to the new Brandenburg WWTP.

A hydraulic model wasn't performed on the existing or proposed collection system for this Facilities Plan. If the City proceeds with designing and constructing the following planning phases, the completion of a hydraulic model is recommended. A hydraulic model would help establish capacity issues that exist with the system. In addition to CCTV identifying the areas that would potentially need to be replaced or rehabilitated, the model would be useful in establishing which sewers require upsizing.

a. 3-10 Year Planning Phase

Table 7-4 below summarizes the proposed 3-10 year collection system expansion to the existing Brandenburg Collection. The planning phase consists of two existing neighborhoods, located south of the existing service area (See Exhibit 2-6). In order to serve the neighborhoods, a combination of gravity sewer and force main will be required. The Four Oaks Road neighborhood will serve 22 houses along Four Oaks Road, Miles Lane, and Bruno Circle. A 4" force main from the neighborhood will tie into the collection system at a manhole near Armory Place. The Quail Run and Knollwood Road neighborhood will serve 83 houses along Old State Road, Knollwood Road, Kelly Lane, Quail Run Road, Oakwood Drive, Rebecca Court, and Blaine Court. A 4" force main from the neighborhood will tie into the collection system at a manhole off Old State Road.

Table 7-4 3-10 Year Planning Phase Proposed Collection System Expansion		
Four Oaks Road Neighborhood		
Gravity Sewer	8”	2,440’
Force Main	2”	910’
	4”	1,640’
Duplex Lift Stations	2	
Quail Run and Knollwood Road Neighborhood		
Gravity Sewer	8”	11,770’
Force Main	4”	2,810’
Duplex Lift Stations	7	

b. 11-20 Year Planning Phase

Table 7-5 below summarizes the proposed 11-20 year collection system expansion to the existing Brandenburg Collection. The planning phase consists of three existing neighborhoods and potential agricultural and industrial growth (See Exhibit 2-6). The three existing neighborhoods will be served by a combination of gravity sewer and force main will be required The River Edge Road neighborhood will serve 21 houses along River Edge Road, River Edge Drive, and KY 228. An 8” gravity sewer from the neighborhood will tie into the collection system at the Brandenburg Bypass Pump Station. The Windsor Place and Sun Valley Road neighborhood will serve 61 houses along Fairground Road, Sun Valley Road, and Windsor Place. An 8” gravity sewer from the neighborhood will tie into the collection system at the Fairgrounds Road Pump Station. The Christian Church and Bud Wilson Road neighborhood will serve 65 houses along Christian Church and Bud Wilson Road. A 4” force main from the neighborhood will tie into the collection system at a manhole on Ready Mix Road.

Table 7-5 11-20 Year Planning Phase Proposed Collection System Expansion		
River Edge Road Neighborhood		
Gravity Sewer	8”	5,320’
Windsor Place and Sun Valley Road Neighborhood		
Gravity Sewer	8”	7,820’
Force Main	4”	2,000’
Duplex Lift Stations	1	
Christian Church and Bud Wilson Road Neighborhood		
Gravity Sewer	8”	8,780’
Force Main	2”	1,700’
	4”	4,150’
Duplex Lift Stations	7	

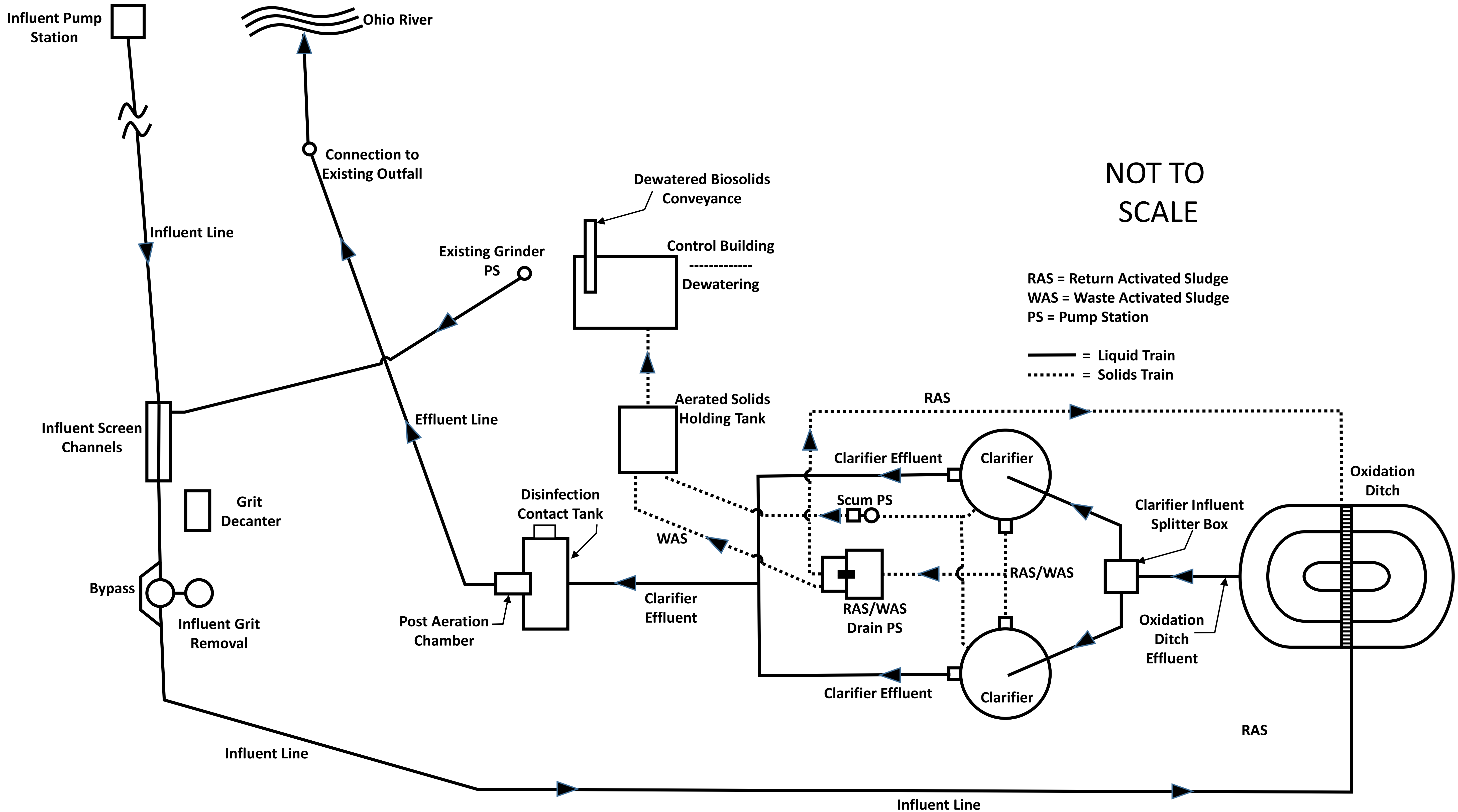

Exhibit 7-1

WASTEWATER FACILITIES PLAN
CITY OF BRANDENBURG, KENTUCKY

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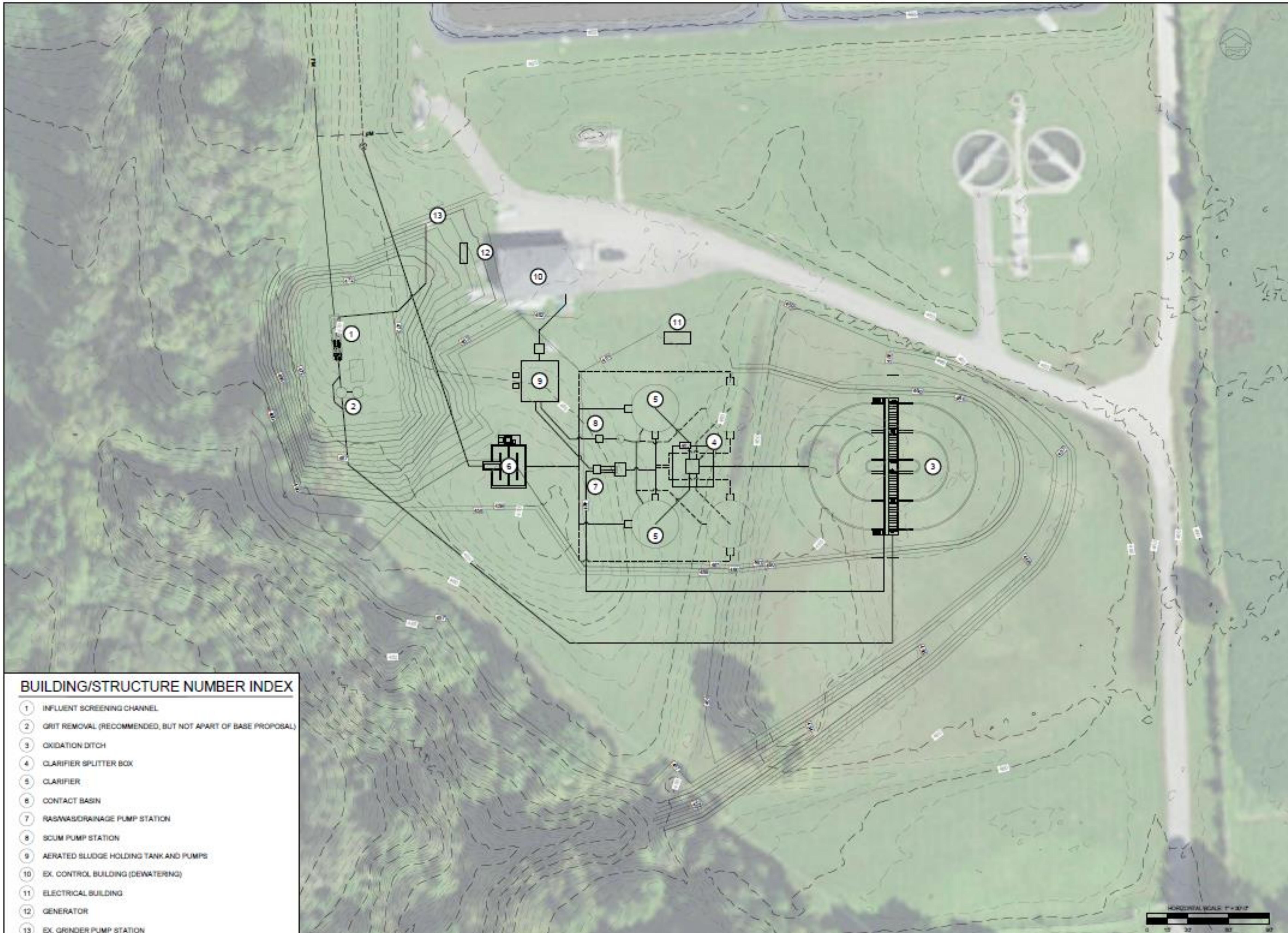

BUILDING/STRUCTURE NUMBER INDEX

1. INFLUENT SCREENING CHANNEL
2. GRIT REMOVAL (RECOMMENDED, BUT NOT APART OF BASE PROPOSAL)
3. OXIDATION DITCH
4. CLARIFIER SPLITTER BOX
5. CLARIFIER
6. CONTACT BASIN
7. RAS/WAS/DRAINAGE PUMP STATION
8. SCUM PUMP STATION
9. AERATED SLUDGE HOLDING TANK AND PUMPS
10. EX. CONTROL BUILDING (DEWATERING)
11. ELECTRICAL BUILDING
12. GENERATOR
13. EX. GRINDER PUMP STATION

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PROCESS AND PIPING LAYOUT
OXIDATION DITCH OPTION

WASTEWATER TREATMENT PLANT P3
CITY OF BRANDENBURG, KENTUCKY

JVP
NWG
JVP
JVP

EXHIBIT 7.2
SELECTED ALTERNATIVE

1" = 30'

OD-1

Chapter 8
Public Participation, Resolution and Authority

A. Purpose

The purpose of this chapter is to discuss the efforts by the City of Brandenburg to encourage public participation throughout the course of the plan preparation. The City considers the input of the public vital to the development of a functional plan consistent with the goals and objectives discussed in previous chapters. This chapter also presents the City and County resolution adopting the plan and the Statement of Authority and Resources for the plan.

B. Facilities Plan Development

The City of Brandenburg has actively participated throughout the development of this study. The Mayor of Brandenburg (Ronnie Joyner) and Public Works Director (T.J. Hughes) were both involved in numerous meetings with GRW to develop the Facilities Plan.

In addition, various agencies including the Kentucky Division of Water, US Fish and Wildlife, Kentucky Fish and Wildlife, US Army Corps of Engineers, State Historic Preservation Office, US Natural Resource Conservation Service, the Local Health Department, and others were contacted to assist in evaluation of the planning area.

C. Public Hearing

A public hearing will be held on January 11, 2021 in Brandenburg prior to the City Council meeting to present and discuss the Wastewater Facilities Plan to the City Council and Public. A public hearing notice will be published in the local newspaper in order to secure public participation. Appendix H contains the public hearing presentation, minutes, questions and answers, sign-in sheet, newspaper notices and affidavits from the newspaper showing the notice dates.

D. City and County Resolution Endorsing Plan

A copy of the City and County resolution endorsing the wastewater facilities plan is included in Appendix G.

E. Statement of Authority and Resources

The selected alternative for the Brandenburg Planning Area has been reviewed and approved by the City of Brandenburg, who will implement the Plan. The fiscal commitment necessary to implement the selected alternative is significant. The City has made a commitment to the citizens to provide the Planning Area with the most cost effective, environmentally sound, and implementable wastewater collection and treatment system which will meet all applicable Federal, State, and Local requirements.

Chapter 94 of the Kentucky Revised Statutes provides authorization for cities of all classes in Kentucky to provide sewerage facilities within and outside their corporate limits. Chapter 82 of the Kentucky Revised Statutes provides authorization for cities to finance public improvements through the issuance of either general obligation or revenue bonds. By having the legal authority to adjust user charges as necessary to implement the projects, Brandenburg has the financial capability to fund the selected alternative.

The City of Brandenburg has the necessary legal, financial, institutional and managerial resources to ensure the construction and annual O&M of the proposed improvements.

Chapter 9
Sewer Use Rates

A. *Purpose*

The purpose of this section is to present projected user costs and financing options for the selected project.

B. *User Costs*

The selected treatment plant upgrade alternative (Alternative 1 – Oxidation ditch and secondary clarifiers) is recommended in the 0-2 year planning period. The projected annual operation and maintenance cost for the upgrade is $497,763 and the estimated total project cost for the new wastewater treatment plant is $8,300,600.

A preliminary sewer use rate analysis has been completed using a Public-Private Partnership (P3) approach and the City of Brandenburg guaranteeing the loan for the new wastewater treatment plant through the issuance of bonds. The analysis result is included as Exhibit 9-1. No impact fees (i.e. new user tap fees) or recapture agreement fees were considered in the rate analysis. The funding scenario evaluated includes a loan using a rate identified by the City of Brandenburg as their line of credit rate at 2.65% over 20 years. A copy of Brandenburg's existing user rates and charges can be found in Appendix E.

For funding with a 20 year loan interest rate of 2.65%, sewer use rates are projected to increase across the three user classes established by the City of Brandenburg; Residential, Commercial, and School/Tax Exempt. The following table, Table 9-1, illustrates average rates, by user class at average flows utilizing the rates effective December 1 2020, and average rates in 2040, also by class. The 2040 rates assume a 2.0% annual increase, per ordinance, plus a 1.5% annual increase in expenses and reserves.

Table 9-1
Sewer Use Rates by Class/Year
Average Use Rates

Class	2020	2040
Residential	$42.05	$62.48
Commercial	$55.17	$81.98
School/Tax Exempt	$105.96	$157.45

It should be noted that these are preliminary rate calculations and a more detailed rate study must be completed in order to verify the actual rate increase required. The analysis provided here did not factor in other revenue sources such as new user tap fees or recapture agreement fees. The analysis did include an agreed to payment of one-half the annual loan amount for the 20-year life of the term from Meade County, Kentucky to assist the city and enable them to attract Nucor to the area. In addition, this projected rate increase assumes that the existing finances are neutral and does not include any rate increase which may be necessary to bring current finances to a neutral position.

The collection system expansion recommended for the 3-10 year and 11-20 year planning periods will be implemented based on the City's desire to expand to these existing water system customers. The 3-10 year and 11-20 year collection system expansions were not included in the rate increase projection discussed above. Funding mechanisms will be worked out as the 3-10 and 11-20 year collection system projects are implemented.

C. *Financing Options*

One of the most important issues for any public utility is how to obtain project financing and be self-supporting. The City of Brandenburg's fee structure will need to generate enough revenue to cover debt and operating expenses through the life of any capital improvement projects.

Traditional funding methods include SRF and RD loans, general obligation bonds, and revenue bonds. There are also two other means with which sewer infrastructure could be financed without the City taking on sole responsibility for the debt. These are known as Recapture Agreements and Impact Fees.

1. Recapture Agreements

Growth can be spurred on by situations that encourage developers to build, but don't cause any economic hardship to the City. The use of a Recapture Agreement, similar to what the Louisville and Jefferson County Metropolitan Sewer District (MSD) employs is one of those situations where sewers and wastewater facilities can be constructed without forcing the public utility to front all of the capital.

In Jefferson County, the Agreement essentially allows a developer to construct and pay for regional sanitary sewer facilities — which must be approved by MSD — then transfer those facilities to MSD at no cost. As other properties within the watershed are then built up or urbanized, the developer can recapture the cost when homes or businesses connect to the system. To determine the amount of money a developer would "recapture" per development, they simply take the total project cost and divide it by the projected number of lots over how many years it should take to develop.

This method enables the expansion of sewer service to undeveloped areas surrounding an urban area without the utility going into debt to take on more customers. It should be noted, however, that MSD Recapture Agreements cannot be "piggybacked" onto one another. In other words, if developer "A" constructs one mile of sewer to develop some land they own, developer "B" cannot come back in five years and add another mile of sewer to develop more land upstream.

The reasoning behind the no "piggyback" rule is because then developer "A" may claim that they deserve a portion of the Recapture money from developer "B", seeing as the second development could never have happened had it not been for the sewer extension from the first development. Situations like that could get quite cumbersome and difficult to manage. In MSD's case, they made a decision based not so much on policy, but the ability to implement recapture agreements without creating unwieldy tracking scenarios caused by the "piggyback" situation.

2. Impact Fees

Another method of acquiring money for capital construction projects is through the use of Impact Fees. Generally, the Fees are created through an ordinance, which establishes rates and charges for hooking new residential, commercial, or industrial development onto the system. They are effectively capacity charges, and cover the cost of the municipality providing wastewater collection and treatment facilities. The Impact Fee is one-time only, and is paid prior to connection to the sewerage facilities.

The City of Shepherdsville, Kentucky's Fees Ordinance establishes the estimated flow for a single-family residential unit, while also stating that commercial and business estimated flow will be determined on a case-by-case basis. For developments served by City sewer extension, developers are required to pay the applicable charges immediately upon submission of the development plans to the City, or provide an Irrevocable Letter of Credit from a financial institution.

Shepherdsville's Ordinance based the cost of a gallon of wastewater on the construction costs for expanding their existing treatment plant. That cost was then multiplied by the number of gallons per day a single-family household produced to determine a total cost charged per household.

It should be noted that the flow per household could be calculated in a variety of ways. MSD, for example, assumes four persons per household at 100 gallons per day, equating to 400 gallons per day per household for new development.

Shepherdsville determined their flow per household to be 214 gallons per day for new development. Many municipalities choose to use population per household from census data, and then multiply by 100 gallons per person per day.

For the purpose of this Facilities Plan, since the City of Brandenburg lumps their users into one rate category, the simplest method of calculating flow per capita would be to look at the total wastewater flow into the Brandenburg WWTP and dividing by the total number of customers. As stated in Chapter 4, this equates to 162.6 gallons per day per customer.

3. Traditional Financing

As mentioned earlier, there are traditional methods of financing that the City of Brandenburg had the opportunity to explore. These include, but are not limited to, SRF loans, RD loans, general obligation bonds, and revenue bonds.

a. State Revolving Fund (SRF) Loans

Basic infrastructure — water, sewer, solid waste facilities, etc. — is a necessity for economic growth. Many Kentucky communities do not have that infrastructure available to their citizens, due in large part to the high costs of these services. The Kentucky Infrastructure Authority (KIA) was created in 1988 to provide the mechanism for funding construction of local public works projects. The Federally Assisted Clean Water State Revolving Loan, or Fund A, is the program administered through KIA that is applicable to wastewater.

Fund A has rates based on the Median Household Income (MHI) of the community being served. Effective July 1, 2020 the construction loan rates for Fund A, wastewater projects, are:

- 2.00% for communities with MHI greater than or equal to $48,392
- 1.00% for communities with MHI between $38,715 and $48,391
- 0.25% for communities with MHI less than $38,714

Repayment must be within 20 years of completion of a project, and must commence within one year of project completion. Priority of loan awards is based on project rankings from the water management council, and eligible projects must be for wastewater treatment facilities that comply with the Clean Water Act. An approved Facilities Plan must be included with the project for which funding is requested.

b. USDA Rural Development (RD) Loans

Formerly known as the "Farmers House Administration Program" (FmHA), the RD program is administered by the United States Department of Agriculture (U.S.D.A.). The RD program is primarily for rural residents, small cities, and towns with populations of 10,000 or less. The program uses low interest loan funds and grant funds to asset in the funding of water sanitary sewer projects. Interest rates are adjusted quarterly and may be obtained from any RD office. Currently, the market interest rate is 2.125%, intermediate interest rate is 1.750%, and poverty is 1.250% (rates effective Oct 1, 2020 to Dec 31, 2020). If awarded, grant assistance, in some instances, can be up to 75% of edible project costs. Eligibility requirements for grant assistance are the same as for direct loans. Payback periods for debt service can be as long as 40 years; however, no repayment period will exceed State statutes or useful life of the facility.

Similar to SRF program, RD requires an application submittal along with a Preliminary Engineering Report (PER). Upon approval, a financing package of loans and grants is developed based on community's income level and its ability to meet certain user rate. The RD program estimates an acceptable user rate for the community based on median income levels and rates of similar systems. Consequently, the program typically does not provide grant assistance to projects that would have rates below the acceptable user rate. RD considers acceptable user rates to be in the range of $55 to $65 per month.

The RD program is allocated a certain amount of money each year. Once the demand has exhausted the supply, the applicants are prioritized based on several factors including income levels, service population, health hazards, and violations of local heath ordinances.

c. General Obligation Bonds

General obligation bonds offer investors a relatively safe vehicle for investment, while providing the necessary funds for community improvements to local governments. These bonds are backed by the full faith and credit of the issuing municipality, meaning that the municipality commits its full resources to paying bondholders. This includes general taxation and the ability to raise more funds through credit. The ability to back up these types of bond payments with tax funds is what makes them distinct from revenue bonds, which are repaid using the revenue generated by the specific project the bonds are issued to fund (i.e. sewer use fees).

The default risk of general obligation bonds is low due to the fact that the municipality has the option of raising taxes to meet its obligations. In addition, it is possible for municipalities to repay bondholders by borrowing more money. By calling a bond issue when interest rates fall, the municipality is stating that they will repay the principal before the bond matures. They can then re-fund the debt by making a new bond issue at a lower rate of interest, saving money in the process.

General obligation bonds give municipalities a tool with which to raise funds for projects that will not provide direct sources of revenue. As a result, they are typically used to fund projects that will serve an entire community. Revenue bonds, on the other hand, are used to fund projects that serve specific populations, who provide the revenue to repay the debt through user fees.

d. Revenue Bonds

Revenue bonds make up the vast majority of municipal bonds, and are available in a variety of issues. They are a type of municipal bond that is secured by a specific income of the issuer, which distinguishes them from general obligation bonds.

These types of bonds finance income-producing projects, and the income generated by these projects pays revenue bondholders their interest and principal. Projects funded by these types of bonds serve only that portion of a community that pays for it. In contrast, general obligation bonds do not produce income, but provide services for the entire community.

Most revenue bonds are sold in $5,000 units and mature in 20 to 30 years. However, not all the bonds in an issue necessarily mature at the same time — they may be staggered. The types of bonds with staggered maturity dates are called serial bonds.
Income from a municipal enterprise is placed into a revenue fund. From this fund, operations expenses are paid first. Only after this has occurred do revenue bondholders receive their payments.

Unlike general obligation bonds, revenue bonds are secured by specific collateral — the income produced by the projects they fund. The revenues (i.e. sewer use fees) produced are then used to pay investors.

Revenue bonds offer higher interest rates than general obligation bonds. This is because the income from the projects they fund cannot be predicted with absolute certainty, which adds to the perception of lower safety. If the projects do not produce enough revenue, the bonds may default.

Ratings firms rate revenue bond issuers for their ability to pay back both interest and principal. Bond analysts study the issuer's ability to produce income sufficient enough to make payments. They also evaluate the cash flow of the income source, since the success of a bond ultimately depends on the project's ability to produce revenue.

4. Project Financing Plan

As noted, the City of Brandenburg has selected a Public-Private Partnership (P3) with the issuance of bonds to repay the construction loan for the new wastewater treatment plant. Brandenburg will need to conduct a detailed Sewer Use Rate study to further refine the actual additional cost. The Study will indicate how City needs to structure sewer user rates in order to pay debt service, operation, and maintenance costs for the system.

Exhibit 9-1
Brandenburg Facilities Plan
Proposed Rate Schedule - 2.65% Interest Loan
Revenue Required
Phase I (0-2 Year Planning Period)

Total Project Cost - New WWTP		$8,300,600
Proposed Loan Amount		$8,300,600
Annual Debt Service		$540,033
20 years @	2.65%	
Meade County Annual Subsidy (1/2 Project Cost)		$270,017
Estimated Annual O & M		$497,763
Total Annual Revenue Required		**$767,780**

User Types	Current No.	Current Avg Monthly Bill	Current Annual Revenue
Residential	965	$42.05	$486,939
Commercial	201	$55.17	$133,070
School & Tax Exempt	15	$105.96	$19,073
Total	**1,181**		**$639,082**

Assume 200 new residential customers and 10% commercial growth due to Nucor at the end of Year 5

Assume rates increase at 2% each year per City ordinance and expenses/ reserves increase by 1.50% each year.

User Types	Year 20 Estimated No.	Year 20 Avg Monthly Bill	Year 20 Annual Revenue
Residential	1,165	$62.48	$873,528
Commercial	221	$81.98	$217,410
School & Tax Exempt	15	$157.45	$28,341
Total	**1,401**		**$1,119,279**